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Urban Hydrology for Small Watersheds

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PREFACE

This technical release was prepared by hydraulic engineers from the Engineering and Watershed Planning Unit (E&WP), Upper Darby, Pa., and the Central Technical Unit, Hyattsville, Md. Valuable contributions were received from the Engineering Division, Washington, D.C., E&WP Units at Lincoln, Nebr., Portland, Oreg., and Fort Worth, Tex., and from state hydrologists and engineers.

This technical release is presented as a guide for field personnel in estimating the effects of land use changes and structural measures on hydraulic and hydrologic parameters, runoff volume, and peak rates of discharge. Field engineers should recognize that some of the proposed methods are in the formative stage and thus have not been fully tested. The results should be compared with other available methods, and engineering judgment should be used in arriving at a final estimate. Careful consideration should be given to the scope and importance of the job when deciding on a particular procedure. It is not intended that all procedures fit all situations that arise.

As more data become available procedures described in this technical release will be revised.

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

TECHNICAL RELEASE NO. 55

URBAN HYDROLOGY FOR SMALL WATERSHEDS

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CHAPTER 1

EFFECTS OF URBANIZATION ON RUNOFF VOLUME AND PEAK RATES OF DISCHARGE

Introduction

This technical release analyzes the effects of urbanization in a watershed on hydraulic and hydrologic parameters and presents methods of estimating runoff volume and peak rates of discharge. Obtaining basic data on runoff volume and peak rates of discharge is difficult because conditions are constantly changing during the transition from rural to urban land use. At this time only general empirical relationships between the parameters that affect runoff and peak rates of discharge can be developed. Much research is being undertaken to better analyze the effects of urbanization through collection of runoff data and study of watershed models. Reports of progress in this field are being made continually. For additional information see the bibliography in appendix A.

As population density and land values increase, the effects of uncontrolled runoff become an economic burden and a serious threat to the health and well-being of a community and its citizens. Emphasis must be placed on providing solutions to the water problems caused by radical changes in land use. Estimating the magnitude and frequency of future flood events makes possible systematic planning and installation of structural and nonstructural measures to reduce hazards to acceptable levels.

Management of runoff from even minor storms is rapidly becoming an engineering requirement of local and state governments to help reduce flooding and stream erosion. Rapid deterioration of stream channels caused by increased storm runoff has had a detrimental impact on communities. Counties and states are adopting policies which limit the effects that changes in land use may have on the stream regimen within a development or watershed. These policies cover such areas as (1) assisting in the planned management of water resources, including storm drainage, throughout the watershed; (2) promoting and encouraging the inclusion of flood storage in all planned reservoirs; and (3) encouraging and assisting in planning for onsite retention of runoff through the use of temporary storage structures and infiltration devices.

There is a need for thorough understanding of the problems associated with the rapid conversion of land use and for adequate technical procedures to assist local communities, municipalities, and planning groups in assessing the effects of changed land use on streamflow.

Effects of Urban Development

An urban or urbanizing watershed can be defined as an area in which all or part of the watershed will be covered by impervious structures, such as roads, sidewalks, parking lots, and houses. Urban stream channels may

also be supplemented by some form of artificial drainage system, such as paved gutters and storm sewers.

The effect of urbanization on the water regimen has long been recognized. Investigations to evaluate the factors involved have been going on for over 35 years. Ideally, hydrologic studies to determine volume and rates of runoff should be based on long-term stationary streamflow records for the area being investigated. Such records are seldom available for small drainage areas, and because of the time involved in converting a watershed from rural to urban conditions, available records normally are not adequate. It becomes necessary to estimate the magnitude and frequency of peak rates of runoff through modeling of measurable watershed characteristics. An understanding of these characteristics is required for judging how to alter parameters to reflect changing watershed conditions.

Urbanization of a watershed changes its response to precipitation. The most common effects are reduced infiltration and decreased travel time, which result in significantly higher peak rates of runoff. The volume of runoff is determined primarily by the amount of precipitation and by infiltration characteristics related to soil type, antecedent rainfall, type of vegetal cover, impervious surfaces, and surface retention. Travel time is determined primarily by slope, flow length, depth of flow, and roughness of flow surfaces. Peak rates of discharge are based on the relationship of the above parameters as well as the total drainage area of the watershed, the location of the development in relation to the total drainage area, and the effect of any flood control works or other manmade storage. Peak rates of discharge are also influenced by the distribution of rainfall within a given storm event. SCS uses three standard rainfall distributions--types I, IA, and II. Type II-distribution applies to all areas of the United States except for parts of the Pacific Coast states. For rainfall distribution in the Pacific Coast states, refer to the map in appendix D.

Volume Parameters

Soil type

Since urban areas are seldom completely covered by impervious structures, soil properties are an important factor in estimating the total volume of direct runoff. The infiltration and percolation rates of soils indicate their potential to absorb rainfall and thereby reduce the amount of direct runoff. Soils having a high infiltration rate (sands or gravels) have a low runoff potential, and soils having a low infiltration rate (clays) have a high runoff potential. Urbanization on soils with a high infiltration rate increases the volume of runoff and peak discharge more than urbanization on soils with a low infiltration rate.

Cover type

The type of cover and its hydrologic condition affects runoff volume through its influence on the infiltration rate of the soil. Fallow land yields more runoff than forested land for a given soil type. Covering areas with impervious material reduces surface storage and infiltration and increases the volume of runoff.

Some rainfall is retained on the surface and by vegetation before runoff begins. Interception is rainfall that is caught by foliage, twigs, branches, leaves, etc. This rainfall is lost to evaporation and thus never reaches the ground surface. Increasing the vegetal cover increases the amount of interception.

Surface depression storage begins when precipitation exceeds infiltration. Overland flow starts when the surface depressions are full. The water in depression storage is not available as direct runoff.

Initial abstraction is the sum of interception, depression storage, and infiltration before runoff begins. It occurs on all types of cover, from pasture in good condition to concrete pavement. However, the amount of initial abstraction is less on concrete pavement than on pasture.

Time Parameters

Slope

Urbanization can change the effective slope of a watershed if flow paths are altered by channelization and by terracing areas for building lots, parking lots, roads, and diversion ditches. The slopes of storm sewers, street gutters, roads, and overland flow areas as well as stream channels are significant in determining travel times through urban watersheds.

Flow length

Flow length may be reduced if natural meandering streams are changed to straight channels. It may be increased if overland flows are diverted through diversions, storm sewers, or street gutters to larger collection systems.

Surface roughness

Flow velocity normally increases significantly when the flow path is changed from flow over rough surfaces of woodland, grassland, and natural channels to sheet flow over smooth surfaces of parking lots, diversions, storm sewers, gutters, and lined channels.

Methodology

Procedures outlined in SCS National Engineering Handbook, Section 4, Hydrology (NEH-4), are adequate for determining volumes, peak rates, and hydrographs of runoff from urban areas. The increase in the volume of runoff due to urbanization depends more on the percentage of impervious area than on any of the other watershed constants. Changes in the time-area relationship (lag time) can be estimated by hydraulic analysis of overland velocities and storage. Changes in channel routing can be estimated by hydraulic analysis of channel velocities and storage.

The soil-cover complex and associated runoff curve number procedure outlined in NEH-4 can be used to measure the change in runoff volume caused by urbanization. Runoff curve numbers for land use and treatment practices

for hydrologic soil groups were developed from daily rainfall records from small agricultural watersheds. By using land use patterns found in an urban area and accounting for impervious areas, a composite weighted curve number representing runoff potential from the watershed can be determined.

Special attention should be given to the computation of time of concentration and travel time. Once storm drains are installed, the flow pattern may be changed so significantly that flow retardance cannot be represented by factors based on runoff curve numbers or overland flow. Velocities of flow through culverts and channels should be computed using hydraulic procedures that take into consideration the characteristics of the flow paths.

When urbanization is proposed in only part of a watershed and peak discharges are desired downstream of the development, consideration should be given to subdividing the watershed into areas of similar land use. The hydrographs from these areas are combined and routed to the outlet.

Methods of determining peak rates of runoff are outlined in chapter 16 of NEH-4. Examples 1 and 2 in chapter 16 of NEH-4 show the development of the total hydrograph. Hydrographs are used when timing effects of tributaries must be analyzed or hydrographs must be routed. Example 4 in chapter 16 of NEH-4 describes a procedure for computing only the peak rate of discharge. This approach can be used when runoff characteristics within a watershed are homogeneous and routing is not required.

Examples in this technical release illustrate the effects of urbanization on volumes and peak rates of runoff using procedures outlined in chapter 16 of NEH-4. Chapter 2 in this technical release discusses runoff volume from urban areas and presents methods of developing runoff curve numbers for urban areas. Chapter 3 discusses time of concentration and travel time as they are affected by urbanization and presents examples of the computation of these parameters. Chapters 4, 5, and 6 present methods of computing peak rates of discharge using standard charts applicable to small drainage areas, charts for preliminary planning and evaluation, and SCS-TR-20 procedures for dealing with more complicated watershed conditions. Chapter 7 reviews methods of surface and subsurface storage used to reduce peak discharges caused by urbanization.

As more information is gathered and analyzed, better procedures may be developed to analyze the effects of urbanization. Procedures presented in this technical release will be revised periodically to incorporate results of future research.

CHAPTER 2

ESTIMATING RUNOFF FROM URBAN AREAS

Introduction

Effective rainfall is that portion of precipitation that produces direct runoff, which is water that enters the stream channels during a storm or soon after and forms a runoff hydrograph. Losses or abstractions are that portion of precipitation that does not contribute to direct runoff. Losses occurring on urban watersheds are similar to those occurring on natural watersheds. The amount of runoff from a storm event largely depends on detention, infiltration, evapotranspiration, etc., and is related to soil type, type of vegetation, and amount of impervious cover.

With proper modifications and assumptions, the soil-cover-complex method described in NEH-4 can be used to estimate runoff from urban areas. The variables used in this method apply to runoff from both agricultural and urban watersheds. A combination of a hydrologic soil group (soil) and a land use and treatment class (cover) is used to determine the hydrologic soil-cover complex. The effect of the hydrologic soil-cover complex on the amount of rainfall that runs off is represented by a runoff curve number, referred to as CN. Chapters 7, 8, 9, and 10 of NEH-4 discuss the development of soil-cover complexes including soils, cover, treatment practices for agricultural areas, and resulting runoff.

In an urban watershed, the cover usually consists of both pervious and impervious surfaces. Impervious surfaces, such as roofs, streets, sidewalks, driveways, and parking lots, have some initial abstraction before runoff occurs. However, during an intense part of a storm event, nearly 100 percent of the rainfall may run off. Both initial abstraction and infiltration should be considered for pervious surfaces such as lawns, parks, and playing fields.

Runoff Equation

Figure 2-1 shows schematic curves of accumulated storm rainfall P, runoff Q, and infiltration plus initial abstraction $(F + I_a)$. For convenience in estimating runoff, initial abstraction includes all the storm rainfall occurring before surface runoff starts.

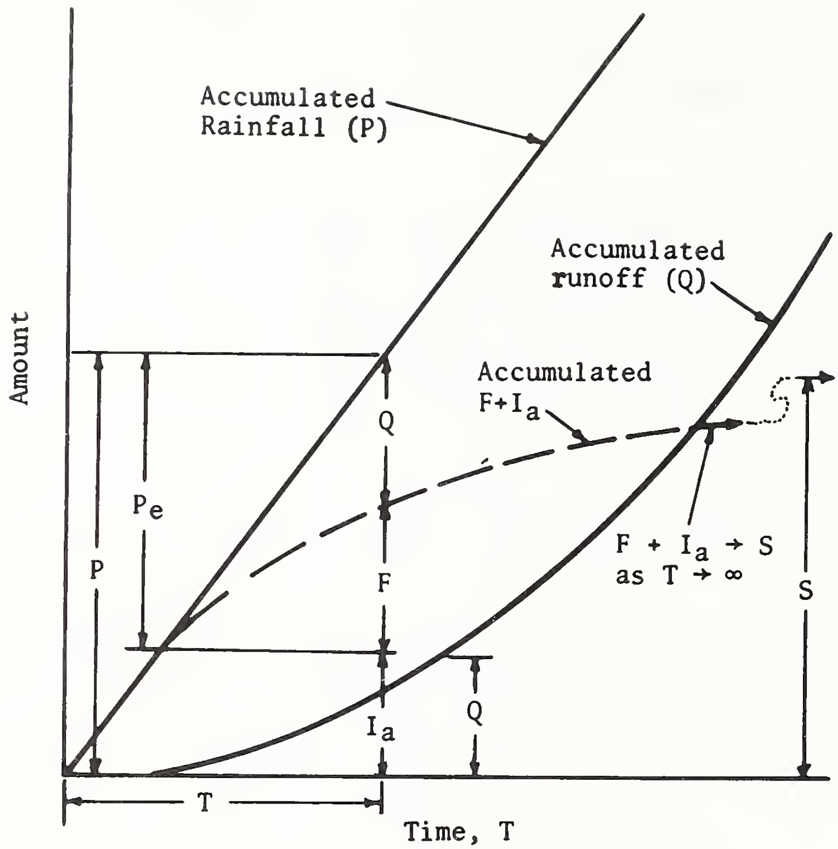

Figure 2-1.--Schematic curves of accumulated rainfall (P), runoff (Q), and infiltration plus initial abstraction ($F + I_a$) showing the relation expressed by equation 2-5.

Assume

$$\frac{F}{S} = \frac{Q}{P_e} \qquad \text{(Eq. 2-1)}$$

where F is the infiltration occurring after runoff begins in inches, S is the potential abstraction in inches, Q is the actual direct runoff in inches, and P_e is the potential runoff or effective storm runoff (storm rainfall minus the initial abstraction) in inches.

With $F = P_e - Q$, equation 2-1 can be written as

$$Q = \frac{P_e^{\,2}}{P_e + S} \qquad \text{(Eq. 2-2)}$$

The initial abstraction (I_a) in inches, estimated from an empirical relation based on data from small watersheds, is

$$I_a = 0.2S \qquad \text{(Eq. 2-3)}$$

Thus

$$P_e = P - I_a = P - 0.2S \qquad \text{(Eq. 2-4)}$$

where P is the total storm rainfall in inches. Substituting equation 2-4 in equation 2-2,

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S} \qquad \text{(Eq. 2-5)}$$

Potential abstraction S is related to the soil and cover conditions of a watershed. The runoff curve number, which is also related to soil and cover conditions, is related to potential abstraction S by

$$CN = \frac{1{,}000}{S + 10} \qquad \text{(Eq. 2-6)}$$

from which

$$S = \frac{1{,}000}{CN} - 10 \qquad \text{(Eq. 2-7)}$$

The solution to equation 2-5 is shown in table 2-1 for a range of CN's and total rainfall amounts.

Table 2-1.--Runoff depth in inches for selected CN's and rainfall amounts

Rainfall (inches)	Curve Number (CN)[1/]								
	60	65	70	75	80	85	90	95	98
1.0	0	0	0	0.03	0.08	0.17	0.32	.56	.79
1.2	0	0	0.03	0.07	0.15	0.28	0.46	.74	.99
1.4	0	0.02	0.06	0.13	0.24	0.39	0.61	.92	1.18
1.6	0.01	0.05	0.11	0.20	0.34	0.52	0.76	1.11	1.38
1.8	0.03	0.09	0.17	0.29	0.44	0.65	0.93	1.29	1.58
2.0	0.06	0.14	0.24	0.38	0.56	0.80	1.09	1.48	1.77
2.5	0.17	0.30	0.46	0.65	0.89	1.18	1.53	1.96	2.27
3.0	0.33	0.51	0.72	0.96	1.25	1.59	1.98	2.45	2.78
4.0	0.76	1.03	1.33	1.67	2.04	2.46	2.92	3.43	3.77
5.0	1.30	1.65	2.04	2.45	2.89	3.37	3.88	4.42	4.76
6.0	1.92	2.35	2.80	3.28	3.78	4.31	4.85	5.41	5.76
7.0	2.60	3.10	3.62	4.15	4.69	5.26	5.82	6.41	6.76
8.0	3.33	3.90	4.47	5.04	5.62	6.22	6.81	7.40	7.76
9.0	4.10	4.72	5.34	5.95	6.57	7.19	7.79	8.40	8.76
10.0	4.90	5.57	6.23	6.88	7.52	8.16	8.78	9.40	9.76
11.0	5.72	6.44	7.13	7.82	8.48	9.14	9.77	10.39	10.76
12.0	6.56	7.32	8.05	8.76	9.45	10.12	10.76	11.39	11.76

1/ To obtain runoff depths for CN's and other rainfall amounts not shown in this table, use an arithmetic interpolation.

Effect of Urbanization on Runoff

Initial abstraction consists of interception, infiltration, and depression storage that must be satisfied before runoff begins. Urban initial abstraction has been found to be correlated with slope of the impervious area. However, because of the limited scope of the research data available, no attempt has been made to revise the basic runoff equation to apply exclusively to urban areas.

Investigations have also shown that runoff from small (less than annual) rainfall events comes primarily from the impervious areas. However, both the pervious and impervious areas contribute to runoff for the larger, less frequent events. If the pervious portion of an urban area has a CN of 60 to 65, approximately 2 inches of rainfall is needed before runoff begins. Most 24-hour rainfall values used in computing peak rates of flow are over 2 inches. Therefore, for urban analysis the total watershed area can be assumed to contribute to storm runoff.

Urban Runoff Curve Numbers

Several factors should be considered when computing the anticipated future CN for urban areas. The amount of runoff can vary depending on whether house gutters connect directly to storm drains, outlet onto impervious driveways, or outlet onto lawns or other pervious areas where infiltration can occur. General building practices or codes within a development may be helpful in determining runoff flow paths. Some areas have zoning ordinances on how storm runoff from individual houses must be handled.

In determining urban CN's, consideration should be given to whether heavy equipment compacted the soil significantly more than natural conditions, whether much of the pervious area is barren with little sod established, and whether grading has mixed the surface and subsurface soils causing a completely different hydrologic condition. Any one of the above could cause a soil normally in hydrologic group A or B to be classified in group B or C, respectively. In many areas of the country, lawns are heavily irrigated. This may significantly increase the moisture content in the soil over that under natural rainfall conditions.

Table 2-2 gives CN's for agricultural, suburban, and urban land use classifications. The suburban and urban CN's are based on typical land use relationships that exist in some areas. They should only be used when it has been determined that the area under study meets the criteria for which these CN's were developed.

There will be areas to which the values in table 2-2 do not apply. The percentage of impervious area for the various types of residential areas or the land use condition for the pervious portions may vary from the conditions assumed in table 2-2. A curve for each pervious CN can be developed to determine the composite CN for any density of impervious area. Figure 2-2 has been developed assuming a CN of 98 for the impervious

Table 2-2.--Runoff curve numbers for selected agricultural, suburban, and urban land use. (Antecedent moisture condition II, and $I_a = 0.2S$)

LAND USE DESCRIPTION	HYDROLOGIC SOIL GROUP			
	A	B	C	D
Cultivated land[1]: without conservation treatment	72	81	88	91
: with conservation treatment	62	71	78	81
Pasture or range land: poor condition	68	79	86	89
good condition	39	61	74	80
Meadow: good condition	30	58	71	78
Wood or Forest land: thin stand, poor cover, no mulch	45	66	77	83
good cover[2]	25	55	70	77
Open Spaces, lawns, parks, golf courses, cemeteries, etc.				
good condition: grass cover on 75% or more of the area	39	61	74	80
fair condition: grass cover on 50% to 75% of the area	49	69	79	84
Commercial and business areas (85% impervious)	89	92	94	95
Industrial districts (72% impervious).	81	88	91	93
Residential:[3]				
Average lot size — Average % Impervious[4]				
1/8 acre or less — 65	77	85	90	92
1/4 acre — 38	61	75	83	87
1/3 acre — 30	57	72	81	86
1/2 acre — 25	54	70	80	85
1 acre — 20	51	68	79	84
Paved parking lots, roofs, driveways, etc.[5]	98	98	98	98
Streets and roads:				
paved with curbs and storm sewers[5]	98	98	98	98
gravel	76	85	89	91
dirt	72	82	87	89

1/ For a more detailed description of agricultural land use curve numbers refer to National Engineering Handbook, Section 4, Hydrology, Chapter 9, Aug. 1972.

2/ Good cover is protected from grazing and litter and brush cover soil.

3/ Curve numbers are computed assuming the runoff from the house and driveway is directed towards the street with a minimum of roof water directed to lawns where additional infiltration could occur.

4/ The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.

5/ In some warmer climates of the country a curve number of 95 may be used.

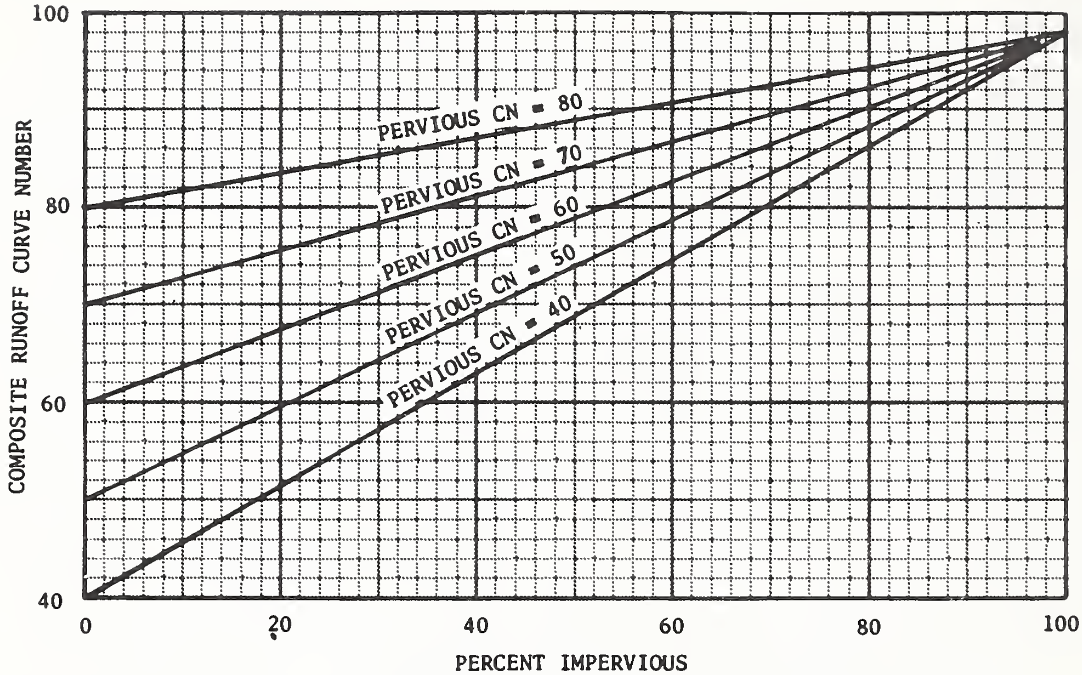

Figure 2-2.--Percentage of impervious areas vs. composite CN's for given pervious area CN's.

area. The curves in figure 2-2 can help in estimating the increase in runoff as more and more land within a given area is covered with impervious material.

There are a number of methods available for computing the percentage of impervious area in a watershed. Some methods include using U.S. Geological Survey topographic maps, land use maps, aerial photographs, and field reconnaissance. Care must be exercised when using methods based on such parameters as population density, street density, and age of the development as a means of determining the percentage of impervious area. The available data on runoff from urban areas are not yet sufficient to validate widespread use of these methods.

Example 2-1
Compute the runoff from 5 inches of rainfall for a 1,000-acre watershed to be converted to a suburban development. All the soils are in hydrologic soil group C. The proposed land use is 50 percent detached houses with lot size 1/4 acre; 10 percent townhouses with lot size 1/8 acre; 25 percent streets with curbs and gutters, schools, parking lots, plazas; and 15 percent open space, parks, schoolyards, etc., with good grass cover.

1. Compute the weighted runoff curve number.

Land use	Percent	Table 2-2 curve number	Product
Detached houses with lot size 1/4 acre	50	83	4,150
Townhouses with lot size 1/8 acre	10	90	900
Streets with curbs, plazas, etc.	25	98	2,450
Open space, parks, etc.	15	74	1,110
	100		8,610

Thus

$$\text{Weighted CN} = \frac{8,610}{100} = 86$$

2. From table 2-1 using CN = 86 and P = 5 interpolate to read Q = 3.47 inches.

Example 2-2

Compute the runoff from 6.3 inches of rainfall for a 1,000-acre watershed to be converted to a suburban development. The soils are in hydrologic soil group B. Forty percent of the development is impervious with all impervious areas connected; 60 percent is pervious and considered to be in good grass cover.

1. From table 2-2 read pervious CN = 61.
2. From figure 2-2 read CN = 76.
3. From table 2-1 using CN = 76 and P = 6.3 interpolate to read Q = 3.64 inches.

Example 2-3

Compute the runoff curve number for a 1,000-acre watershed. The hydrologic soil group is 50 percent B and 50 percent C interspersed throughout the watershed. The land use is:

40 percent residential area that is 30 percent impervious

12 percent residential area that is 65 percent impervious

8 percent paved roads with open ditches

10 percent paved roads with curbs and storm sewers

16 percent open land with 50 percent fair cover and 50 percent good cover

14 percent parking lots, plazas, schools, etc. (all impervious)

Using table 2-2 and figure 2-2, display the data given and compute th runoff curve number.

Land use	Hydrologic soil group B Pct.	CN	Product	Hydrologic soil group C Pct.	CN	Product
Residential (30 pct. impervious)	20	72	1,440	20	81	1,620
Residential (65 pct. impervious)	6	85	510	6	90	540
Roads with open ditches	4	89	356	4	92	368
Roads with curbs and sewers	5	98	490	5	98	490
Open land:						
Fair cover	4	69	276	4	79	316
Good cover	4	61	244	4	74	296
Parking lots, plazas, etc.	7	98	686	7	98	686
	50		4,002	50		4,316

Thus

$$\text{Weighted CN} = \frac{4{,}002 + 4{,}316}{100} = 83.18 \text{ (use 83)}$$

Example 2-4

A 175-acre watershed is 30 percent agricultural and 70 percent urban land. The agricultural area is 40 percent cultivated land with conservation treatment, 35 percent meadow in good condition, and 25 percent forest land with good cover. The urban area is residential: 60 percent is 1/3-acre lots, 25 percent is 1/4-acre lots, and 15 percent is streets and roads with curbs and storm sewers. The entire watershed is in B hydrologic soil group.

Display the data given and compute the weighted composite runoff curve number using curve numbers for the given land use in table 2-2.

Land use	Acres	Curve Number	Product
Agricultural:	(52)		
Cultivated land (conservation treatment)	21	71	1,491
Meadow (good cover)	18	58	1,044
Forest (good cover)	13	55	715
Urban:	(123)		
1/3-acre lots	74	72	5,328
1/4-acre lots	31	75	2,325
Streets and roads with curbs and storm sewers	18	98	1,764
	175		12,667

Thus

$$\text{Weighted CN} = \frac{12{,}667}{175} = 72.4 \text{ (use 72)}$$

CHAPTER 3

TIME OF CONCENTRATION, TRAVEL TIME, AND LAG

Introduction

Urbanization commonly increases the velocity at which water can flow from its point of impact on the watershed to the watershed outlet. Time of concentration, travel time, and watershed lag are three related watershed parameters directly affected by the increased velocity. These parameters are widely used in determining peak rates of runoff.

Time of concentration is the time it takes for runoff to travel from the hydraulically most distant part of the watershed to the point of reference. It is usually computed by determining the water travel time through the watershed. In hydrograph analysis it is the time from the end of excessive rainfall to the point of inflection on the falling limb of the hydrograph. Lag can be considered as a weighted time of concentration and is related to the physical properties of a watershed, such as area, length, and slope. In simple hydrograph analysis, lag is the time from the center of mass of excessive rainfall to the peak rate of runoff. The time of concentration determines the shape of the runoff hydrograph. Thus, changes in the time of concentration cause changes in the resulting hydrograph. The extent of urbanization and stream modification affects the travel time of water through the watershed, which changes the time of concentration.

Two factors can contribute to a decrease in travel time. Urbanization generally decreases overland flow travel time by decreasing flow retardance and by reducing the interflow distance because there are more points of interception by gutters and other conveyances. Channelization decreases travel time by increasing velocities in improved channels. The travel path may be on the surface of the ground or below it (as subsurface flow) or in a combination of both. Urban hydrology studies have shown that the response time of subsurface flow is so much longer than that of surface flow that only surface (including sewer) flow travel time is of significance when determining peak discharges.

Computation of Travel Time

Overland flow, storm sewer or road gutter flow, and channel flow are the three phases of direct flow commonly used in computing travel time.

Overland flow

The travel time for overland flow in an urban area consists of the time it takes water to travel from the uppermost part of the watershed to a defined channel or inlet of the storm sewer system. This type of flow is significant in very small watersheds because a high proportion of travel time is due to overland flow. The velocity of overland flow can vary greatly with the surface cover and tillage as shown in figure 3-1. If the slope and land use of the overland flow segment are known, the average flow velocity can be read from figure 3-1. The travel time is

then computed by dividing the total overland flow length by the average velocity.

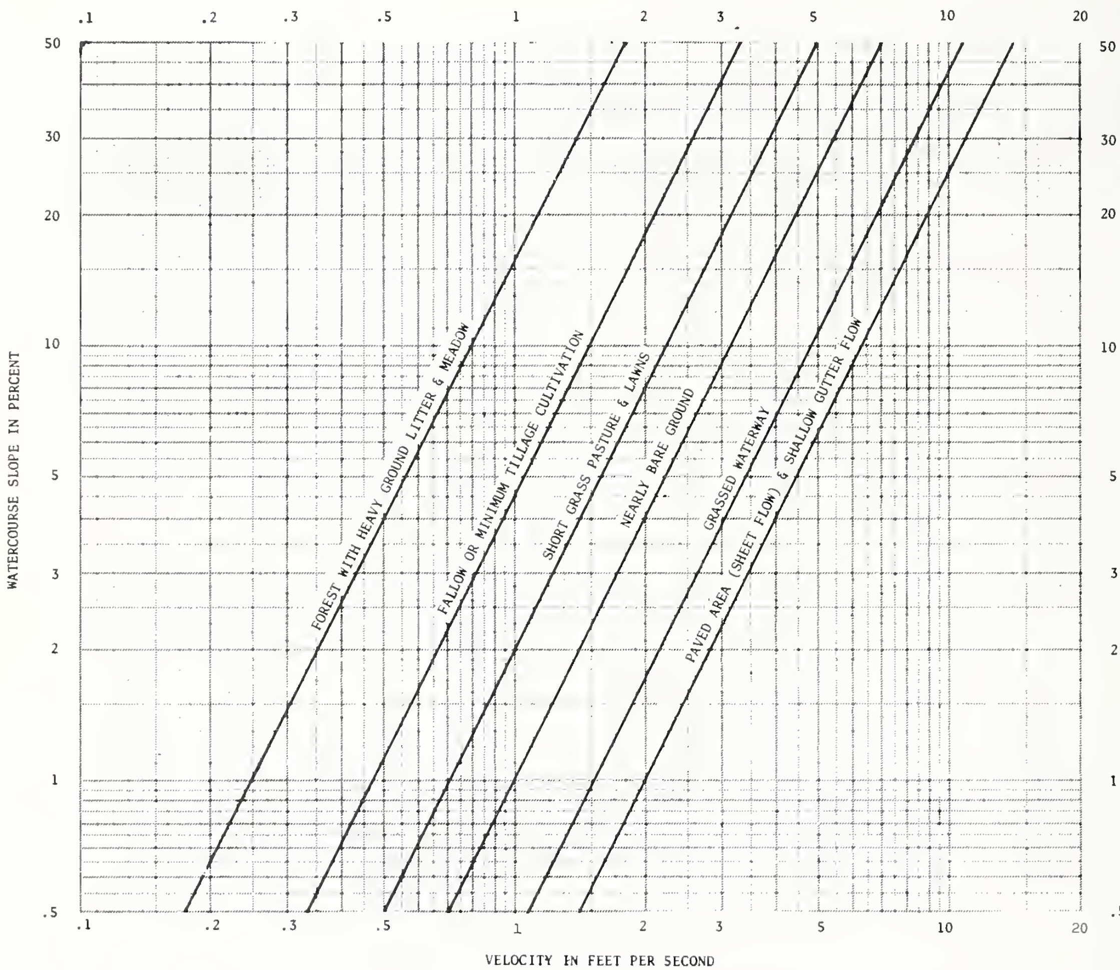

Figure 3-1.--Average velocities for estimating travel time for overland flow.

<u>Storm sewer or road gutter flow</u>
Travel time through the storm sewer or road gutter system to the main open channel is the sum of travel times in each individual component of the system between the uppermost inlet and the outlet. In most cases average velocities can be used without a significant loss of accuracy. During major storm events, the sewer system may be fully taxed and additional overland flow may occur, generally at a significantly lower velocity than the flow in the storm sewers. By using average conduit sizes and an average slope (excluding any vertical drops in the system), the average velocity can be estimated using Manning's formula.

Since the hydraulic radius of a pipe flowing half full is the same as when flowing full, the respective velocities are equal. Travel time may

be based on the pipe flowing full or half full. The travel time through the storm sewers is computed by dividing the length of flow by the average velocity. If flow is principally in shallow road gutters, the curve for overland flow in paved areas shown in figure 3-1 can be used to determine average velocity.

Channel flow

The travel time for flow in an open channel from the storm sewer outlet to the watershed outlet (or evaluation or design point) can be determined by using Manning's equation to compute average velocities. Bankfull velocities should be used to compute these averages. Channels may be in either natural or improved condition.

Example 3-1

An urbanized watershed is shown in figure 3-2. Three types of flow conditions exist from the furthermost point of the watershed to the outlet. Compute the travel time (T_t) and time of concentration (T_c) based on the following data:

Reach	Description of flow	Slope	Length
		Percent	Feet
A to B	Overland (forest)	7	500
B to C	Overland (shallow gutter)	2	900
C to D	Storm drain with manhole covers, inlets, etc. ($n = 0.015$; diameter 3 feet)	1.5	2,000
D to E	Open channel, gunite, trapezoidal ($b = 5$; $d = 3$; $z = 1.1$; $n = 0.019$)	0.5	3,000

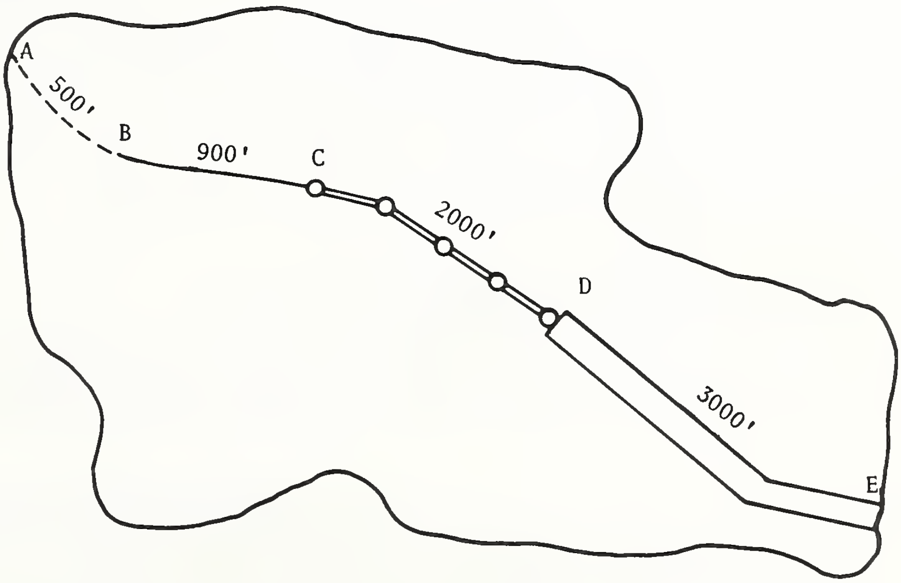

Figure 3-2.--Urban watershed for example 3-1.

1. Compute the overland flow travel time.
Reach A to B (forest cover). From figure 3-1 for a slope of 7 percent read v = 0.7 ft/sec.

$$T_t = \frac{\text{length}}{\text{velocity}} = \frac{500 \text{ ft}}{0.7 \text{ ft/sec}} = 714 \text{ sec}$$

Reach B to C (street gutter). From figure 3-1 for a slope of 2 percent read v = 2.8 ft/sec.

$$T_t = \frac{\text{length}}{\text{velocity}} = \frac{900 \text{ ft}}{2.8 \text{ ft/sec}} = 321 \text{ sec}$$

2. Compute the storm drain flow travel time.
Reach C to D. Use Manning's equation to compute pipefull velocity.

$$v = \frac{1.49}{n}\left(\frac{D}{4}\right)^{2/3} s^{1/2}$$

$$v = \frac{1.49}{0.015}\left(\frac{3}{4}\right)^{2/3} (0.015)^{1/2} = 10 \text{ ft/sec}$$

$$T_t = \frac{\text{length}}{\text{velocity}} = \frac{2{,}000 \text{ ft}}{10 \text{ ft/sec}} = 200 \text{ sec}$$

3. Compute the open channel flow travel time.
Reach D to E. Use Manning's equation to compute bankfull velocity.

$$v = \frac{1.49}{n} r^{2/3} s^{1/2}$$

n = 0.019 for gunite channel

s = 0.005

$$v = \frac{1.49}{0.019} (1.78)^{2/3} (0.005)^{1/2} = 8.2 \text{ ft/sec}$$

$$T_t = \frac{\text{length}}{\text{velocity}} = \frac{3{,}000 \text{ ft}}{8.2 \text{ ft/sec}} = 366 \text{ sec}$$

4. Summary

Reach	Description of flow	Length (ft)	Velocity (ft/sec)	Travel time (sec)
A to B	Overland	500	0.7	714
B to C	Overland	900	2.8	321
C to D	Storm drain	2,000	10.0	200
D to E	Open channel	3,000	8.2	366
			Total	1,601

Thus

$$T_c = \frac{1,601 \text{ sec}}{(3,600 \text{ sec/hr})} = 0.44 \text{ hr}$$

Computation of Lag

The time between a brief heavy rain and the maximum runoff rate is called lag. Lag is a watershed parameter that is often related to time of concentration. It can be estimated from historical hydrographs or it can be estimated from specific watershed characteristics, such as watershed length, slope, and flow retardance. Watershed lag is used to compute peak discharges of the unit hydrograph in equation 4-1 in chapter 4. The same relationship is used in all SCS procedures outlined in chapters 4, 5, and 6.

Hydrograph method

In hydrograph analysis, lag is the time from the center of mass of excess rainfall to the peak rate of runoff. The time difference between the center of excess rainfall and the peak runoff can be determined by analyzing hydrographs from historical storm events. Based on studies of many storm events for a range of watershed conditions, the following empirical relationship between lag and time of concentration was derived:

$$L = 0.6\ T_c \qquad \text{(Eq. 3-1)}$$

This relationship is for average natural conditions and for approximately uniform distribution of runoff over the watershed. A limited study of urban hydrographs shows that this relationship does not differ significantly in urbanized watersheds.

Modified curve number method

In small urban areas (less than 2,000 acres), the curve number method described in chapter 15 of NEH-4 can be used to estimate the time of concentration from watershed lag. The curve number method, originally developed from agricultural watershed data, was intended to span a broad set

of conditions ranging from steep to flat and from heavily forested to smooth. The equation for watershed lag is:

$$L = \frac{\ell^{0.8}(S + 1)^{0.7}}{1,900\ Y^{0.5}} \qquad \text{(Eq. 3-2)}$$

where

L = lag in hours

ℓ = hydraulic length of watershed in feet

$S = \frac{1,000}{CN'} - 10$ (where CN' is the retardance factor and is equivalent to the runoff curve number)

Y = average watershed land slope in percent.

Figure 3-3 shows the solution to equation 3-2 in graph form.

The CN' is a measure of the retardance of surface conditions on the rate at which runoff concentrates at some point in question. Therefore, $(S + 1)^{0.7}$ is a retardance factor based on the surface condition of the watershed.

Data collected from small urban watersheds indicate that the retardance factor CN' generally does not adequately reflect the increased rate at which water can run off as a result of the installation of impervious areas, roads, gutters, and storm drains. Where an area is completely paved, such as a small parking lot, equation 3-2 adequately represents lag. For composite land use areas where streets, gutters, or sewers provide a more efficient flow pattern than lawns, forests, or other pervious areas, equation 3-2 overestimates lag.

Two factors cause the difference between historical measurements of lag and those computed by equation 3-2. The first is the extent to which a stream (usually the major watercourse in the watershed) has been changed over natural conditions either by straightening or by enlarging stream capacity and providing bank protection to allow higher flow velocities than under natural conditions. The second factor is the increased amount of impervious area, which permits water from overland flow sources and side channels to reach the main channel at a much faster rate than under natural conditions.

The weighted runoff curve number, if used as a retardance factor in equation 3-2, does not provide sufficiently for the decrease in lag caused by changes in the main channel and increases in impervious areas. Since urbanization can take place while the main channel is left in its natural state, separate adjustments to the lag equation were derived to account for the effect of each of the two factors on lag.

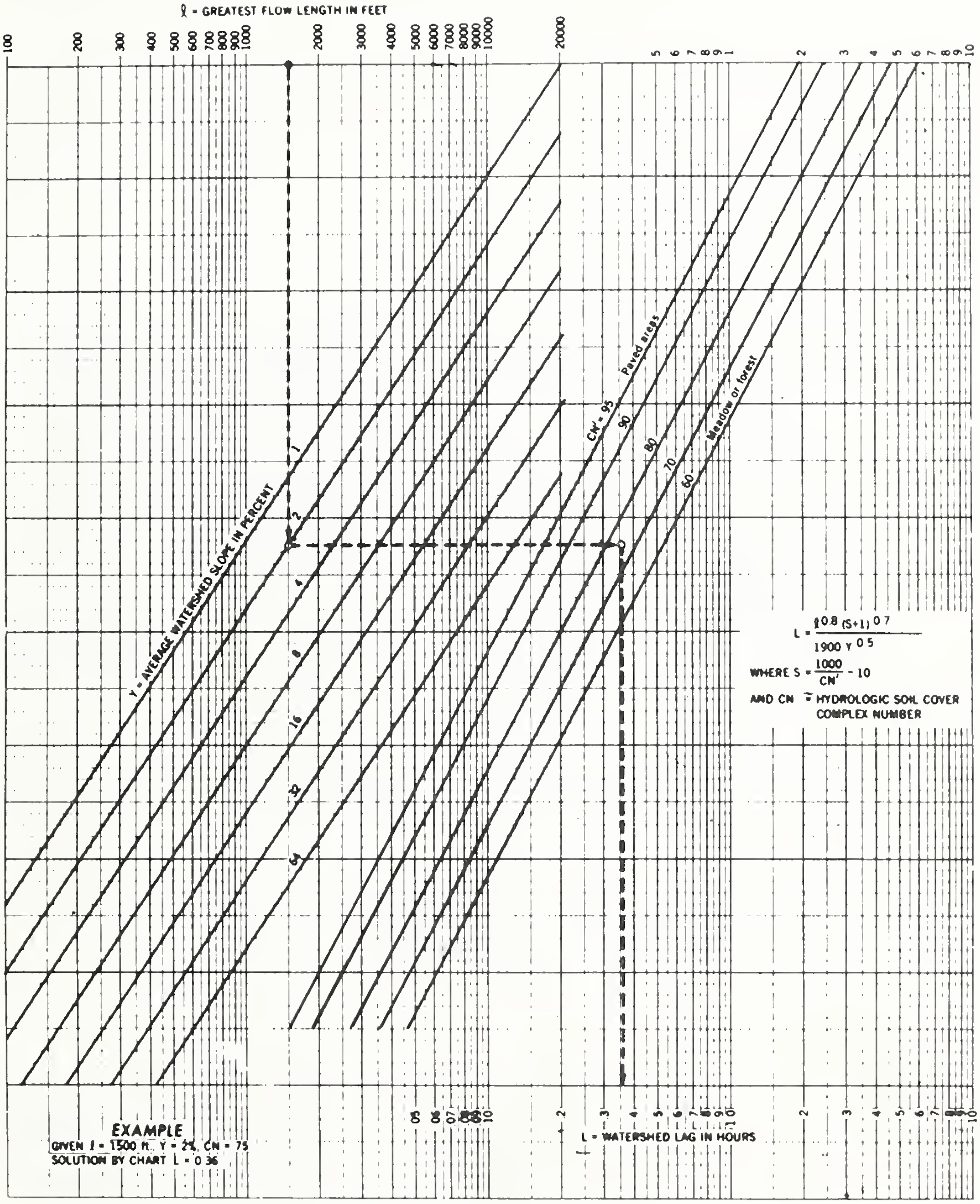

Figure 3-3.--Curve number method for estimating lag (L) for homogeneous watersheds under natural conditions up to 2,000 acres.

Figure 3-4 shows lag factors required to adjust equation 3-2 for watersheds where the natural condition of the main channel has been hydraulically improved. If the main channel has not been modified, the lag computed by equation 3-2 can be used. Not enough data are available, nor is equation 3-2 accurate enough, to distinguish between the types of channel modification made. The adjustment for channel improvement is made as follows. If 50 percent of the channel has been modified from its natural condition and the future-condition curve number is computed to be 80, then the lag computed by equation 3-2 (or read from figure 3-3) is multiplied by 0.7.

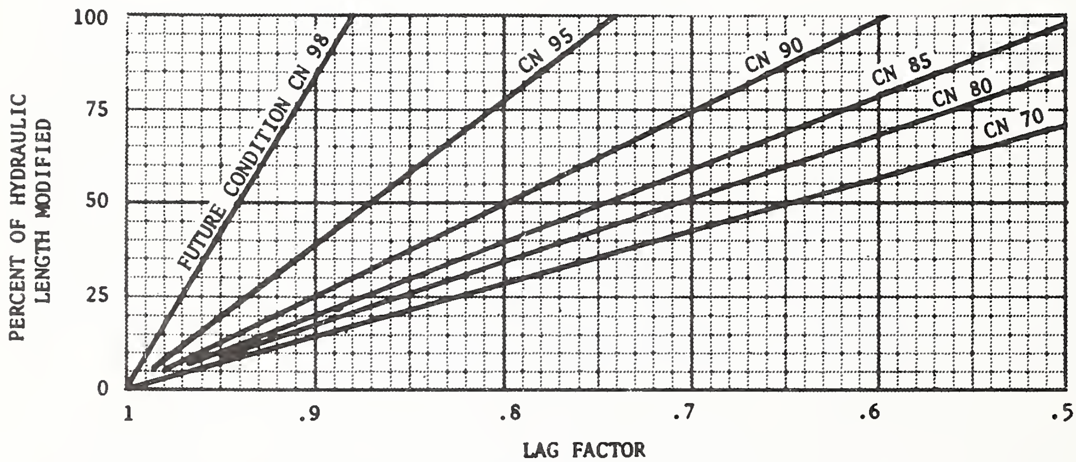

Figure 3-4.--Factors for adjusting lag from equation 3-2 or figure 3-3 when the main channel has been hydraulically improved.

Figure 3-5 shows lag factors for adjusting equation 3-2 if part of the watershed is impervious. If the future-condition curve number is 100 or the impervious area is zero, adjustments are not necessary. When a significant part of the watershed is impervious, time of concentration is decreased because the flow paths to the main channel are more efficient than under natural conditions.

Since figures 3-4 and 3-5 are used only with future-condition curve numbers, the lag factors cannot be used to directly compute the decrease in lag (or time of concentration) from present conditions. To determine the change in lag or time of concentration from present to future conditions, compute the present value and then, using the future-condition curve number, compute the future value.

When only peak discharges from an urban watershed are desired, lag does not have to be computed. Peak factors in figures 4-1 and 4-2, discussed in the next chapter, are used in the same manner as the lag factors when urban modifications to a watershed have occurred. If other procedures are used to compute peaks, but a time of concentration for future conditions is desired without making a detailed survey to determine the

individual overland components of flow, figures 3-4 and 3-5 can be used. Figures 3-4 and 3-5 are approximations at best and have the same limitations and uses as equation 3-2 and figure 3-3.

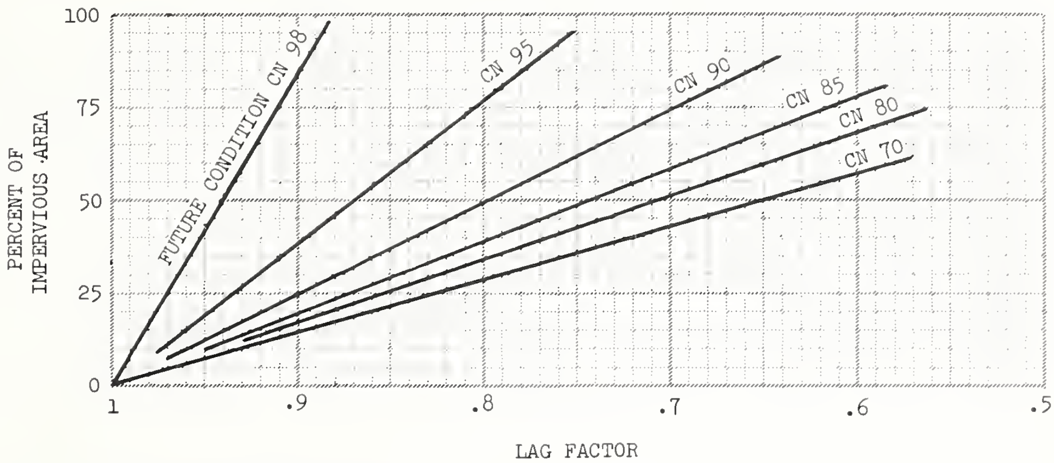

Figure 3-5.--Factors for adjusting lag from equation 3-2 or figure 3-3 when impervious areas occur in the watershed.

Example 3-2

A watershed of 1,000 acres has a present-condition curve number of 75, average watershed slope of 4 percent, and hydraulic length of 13,200 feet. Urban development is expected to modify about 70 percent of the hydraulic length, increase the impervious area to 40 percent, and increase the runoff curve number to 80. Compute the present- and future-condition time of concentration using the curve number method.

1. Present-condition lag from equation 3-2 or figure 3-3 with CN = 75.

$$L = \frac{(13{,}200)^{0.8}(3.33 + 1)^{0.7}}{1{,}900(4)^{0.5}} = 1.45 \text{ hr}$$

2. Present-condition time of concentration from equation 3-1.

$$T_c = 1.67(1.45) = 2.42 \text{ hr}$$

3. Future-condition lag.

   a. Basic future-condition lag with CN = 80:

$$L = \frac{(13{,}200)^{0.8}(2.5 + 1)^{0.7}}{1{,}900(4)^{0.5}} = 1.25 \text{ hr}$$

   b. Lag factor for modification of 70 percent of the hydraulic length from figure 3-4: hydraulic-length lag factor = 0.59

c. Lag factor for 40 percent impervious area from figure 3-5: impervious-area lag factor = 0.76

d. Future-condition lag = 1.25(0.59)(0.76) = 0.56 hr

4. Future-condition time of concentration from equation 3-1.

$$T_c = 1.67(.56) = 0.94 \text{ hr}$$

CHAPTER 4

PEAK DISCHARGES (APPENDIX D CHARTS)

Introduction

A quick and reliable method of computing peak discharges from agricultural drainage areas 1 to 2,000 acres in size is given in charts in appendix D. The charts were prepared for the solution of the general relationships, are based on type-II rainfall distribution, and are applicable to most agricultural areas of the United States. They do not apply to parts of the Pacific Coast states that do not have type-II rainfall distribution, as shown on the map in appendix D.

This chapter presents a method of adjusting peak discharges obtained from the charts in appendix D to reflect the increase in peak discharge due to urbanization. Additional methods for interpolating or adjusting peak discharges for conditions not found on the charts or not represented by the general equations in this chapter are given in appendix E.

Modification of Peak Discharge Due to Urbanization

Research in the area of urban hydrology is developing rapidly. Research to date has been sufficient to identify the parameters that are affected by urbanization and to derive limited empirical relationships between those parameters for both agricultural and urban watersheds. The time to peak for urban watersheds is affected by a decrease in lag or time of concentration as described in chapter 3.

Figures 4-1 and 4-2 give factors for adjusting peaks calculated from charts in appendix D based on the same parameters that affect watershed lag and time of concentration. The factors are applied to the peaks using future-condition runoff curve numbers as follows:

$$Q_{MOD} = Q \left[Factor_{IMP} \right] \left[Factor_{HLM} \right] \qquad \text{(Eq. 4-1)}$$

where

Q_{MOD} = modified discharge due to urbanization

Q = discharge for future CN from appendix D charts

$Factor_{IMP}$ = adjustment factor for percent impervious areas

$Factor_{HLM}$ = adjustment factor for percent of hydraulic length modified.

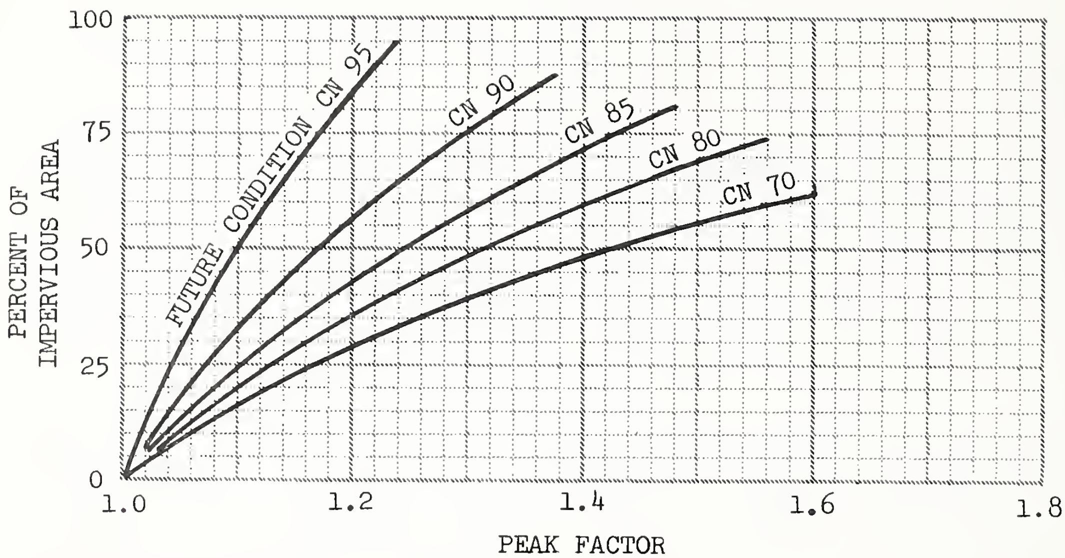

Figure 4-1.--Factors for adjusting peak discharges for a given future-condition runoff curve number based on the percentage of impervious area in the watershed.

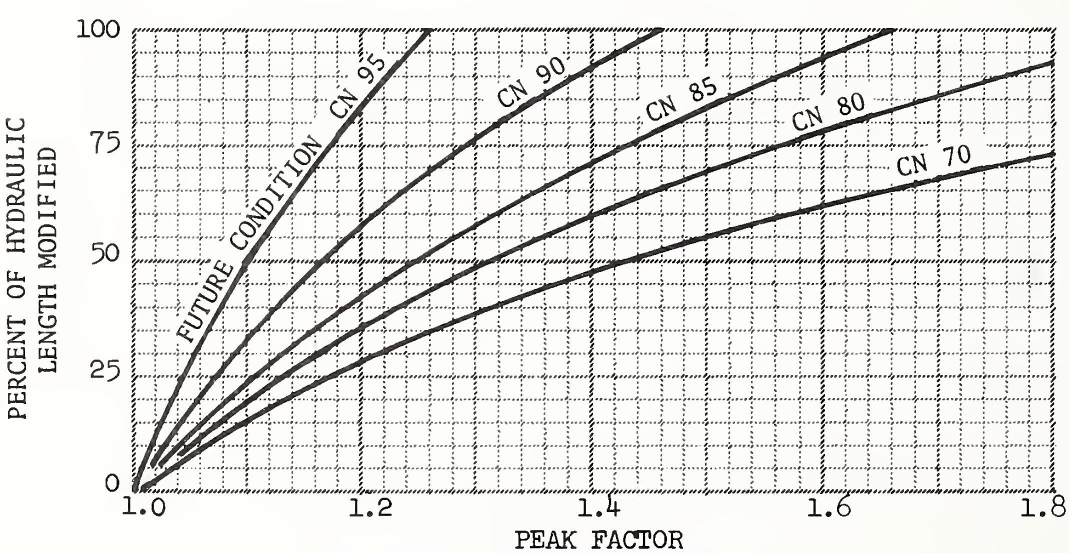

Figure 4-2.--Factors for adjusting peak discharges for a given future-condition runoff curve number based on the percentage of hydraulic length modified.

Example 4-1

A 300-acre watershed is to be developed. The runoff curve number for the proposed development is computed to be 80. Approximately 60 percent of the hydraulic length will be modified by the installation of street gutters and storm drains to the watershed outlet. Approximately 30 percent of the watershed will be impervious. The average watershed slope is estimated to be 4 percent. Compute the present-condition and anticipated future-condition peak discharge for a 50-year 24-hour storm event with 5 inches of rainfall. The present-condition runoff curve number is 75.

1. From table 2-1, the runoff for present condition is 2.45 inches and for future condition is 2.89 inches.

2. From the chart for moderate slope in appendix D (CN = 75), the present condition peak discharge is 120 cfs (cubic feet per second) per inch of runoff. The peak discharge is then 120 x 2.45 or 294 cfs.

3. From the chart for moderate slope in appendix D (CN = 80), the future-condition base discharge for CN = 80 is 133 cfs per inch of runoff. The base discharge is then 133 x 2.89 or 384 cfs.

4. From figure 4-1, with 30 percent impervious area and future runoff curve number of 80, read peak factor = 1.16.

5. From figure 4-2, with 60 percent of the hydraulic length modified and future-condition curve number of 80, read peak factor = 1.42.

6. The future-condition peak discharge is:

$$389\ (1.16)(1.42) = 633 \text{ cfs}$$

7. The effect of this proposed development is to increase the peak discharge from 294 to 633 cfs.

CHAPTER 5

TABULAR AND GRAPHICAL METHODS OF DETERMINING PEAK DISCHARGES

Introduction

This chapter presents tabular and graphical methods for computing peak discharges from urban areas using time of concentration (T_c) and travel time (T_t). These methods are approximations of the more detailed hydrograph analysis, SCS-TR-20 "Computer Program for Project Formulation--Hydrology," discussed in chapter 6.

The tabular method can be used to develop composite hydrographs at any point within a watershed by dividing the watershed into subareas and computing the time of concentration for each subarea and the travel time through each reach. The graphical method uses only the time of concentration and is applicable to a watershed where runoff characteristics are uniform and valley routing is not required. The factors affecting peak discharge calculations discussed in earlier chapters also apply in this chapter: 24-hour rainfall amount, a given rainfall distribution, hydrologic soil-cover complexes (runoff curve numbers), time of concentration, travel time, and drainage area.

The tabular method can be used for watersheds where hydrographs are needed to measure nonhomogeneous runoff, i.e., the watershed is divided into subareas. It is especially applicable for measuring the effects of changed land use in a part of a watershed. It can also be used to determine the effects of structures and combinations of structures, including channel modifications, at different locations in a watershed.

Tabular Method of Determining Peak Discharge

Table 5-3 shows the tabular discharge values for the type-II rainfall distribution used in this procedure. Tabular discharges, in terms of csm (cubic feet per second per square mile) per inch of runoff, are given for a range of T_c's from 0.1 to 2 hours and T_t's from 0 to 4 hours. For T_c's up to 12 hours and T_t's up to 30 hours, refer to TSC Technical Note ENG-UD-20. Values for other distributions are available. Table 5-3 was developed by computing hydrographs for 1 square mile of drainage area for a range of times of concentration and routing them through stream reaches with a range of travel times. A constant runoff curve number of 75 and a rainfall volume sufficient to yield 3 inches of runoff were used.

The tabular method should not be used when large changes in the curve number occur among subareas within a watershed and when runoff volumes are less than about 1.5 inches for curve numbers less than 60. For most watershed conditions, however, this procedure is adequate to determine the effects of urbanization on peak rates of discharge for subareas up to approximately 20 square miles in size.

The computed values of time of concentration (T_c) and travel time (T_t) can be rounded to the nearest value used in table 5-3 or, if more refinement is warranted, the discharges can be computed using the calculated T_c and T_t and interpolating between the T_c and T_t shown in the table. The information needed to calculate the peak discharge at a point in the watershed is:

1. The drainage area of each subarea
2. T_c for each subarea
3. T_t for each routing reach
4. The runoff curve number for each subarea
5. The 24-hour rainfall for a selected frequency
6. The runoff in inches for each subarea

Example 5-1
A developer plans to develop subareas 5, 6, and 7 shown in figure 5-1. The township planning board, before accepting his proposal, wants to know what effect the development would have on the 100-year discharge at the downstream end of subarea 7.

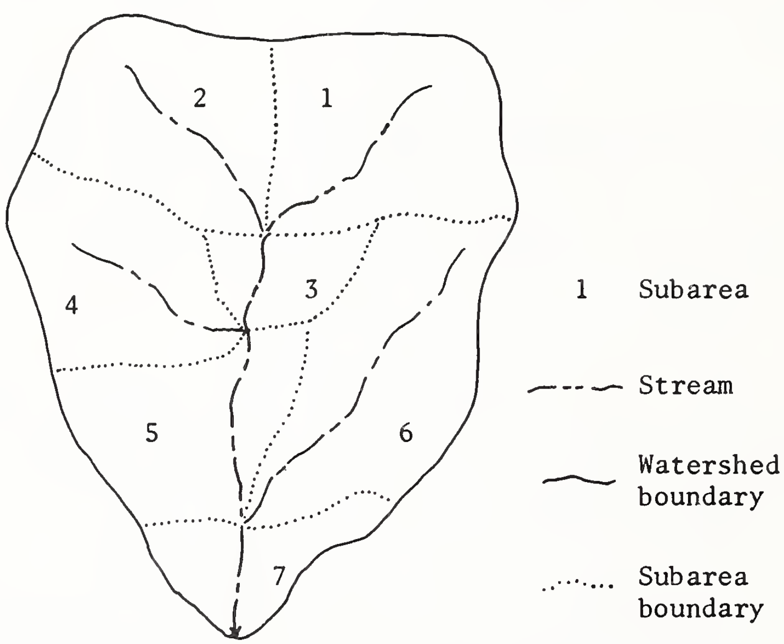

Figure 5-1.—Sample watershed for example 5-1.

1. Develop a table similar to table 5-1, which provides a summary of all the basic data required in the tabular hydrograph method.

Table 5-1.--Basic data used in example 5-1

Sub-area	Drain-age Area (mi^2)	Time of Concentration (hrs)		Runoff Curve Number		Runoff[1/] (in)		Travel time[2/] (hrs)	
		Pres.	Fut.	Pres.	Fut.	Pres.	Fut.	Pres.	Fut.
1	0.3	1.50	1.50	65	65	2.35	2.35	-	-
2	0.2	1.25	1.25	70	70	2.80	2.80	-	-
3	0.1	0.50	0.50	75	75	3.28	3.28	0.25	0.25
4	0.25	0.75	0.75	70	70	2.80	2.80	-	-
5	0.2	1.50	1.50	75	85	3.28	4.31	1.25	1.00
6	0.4	1.50	1.00	70	75	2.80	3.28	-	-
7	0.2	1.25	0.75	75	90	3.28	4.85	0.75	0.50

1/ From Table 2-1 for P = 6 inches.
2/ Travel time through the reach for the corresponding subarea.

2. Develop a flood routing summary table similar to table 5-2 for present and future conditions. The T_t for each subarea is the total travel time for that subarea through the watershed to the point of interest (end of subarea 7). The hydrograph coordinates under time-hours for each subarea are computed using the appropriate sheets from table 5-3 and equation $q = q_p (DA)(Q)$ where:

   q = hydrograph coordinate discharge in cfs (cubic feet per second)
   q_p = csm/in. (cubic feet per second per square mile per inch of runoff)
   DA = drainage area in square miles
   Q = runoff in inches

   Using subarea 4 as an example, for T_c = 0.75 hours use sheet 3 of table 5-3. For T_t = 2.00 hours (the travel time through subareas 5 and 7) the routed peak of subarea 4 appears at the outlet of subarea 7 at 14.0 hours and is 251 csm/in. Therefore, the peak discharge is: $q = 251(.25)(2.80) = 176$ cfs.

3. In order to develop a composite hydrograph at the end of subarea 7, a method of summing the hydrographs from each subarea is used. This method provides a means of adjusting the timing of each hydrograph to allow for the travel time (T_t) from the individual watershed to the point in question. Table 5-2 shows how the present and future discharges are estimated. The effect of the urban development is to increase the 100-year peak discharge from 752 to 894 cfs. Methods for preventing an increase in discharge are discussed in chapter 7.

Table 5-2.--Discharge summary for example 5-1

Present conditions

Sub-area	T_c	T_t	Drainage area	Rain-fall	CN	Run-off	12.5 hr	13.0 hr	13.2 hr	13.5 hr	14.0 hr	14.5 hr	15.0 hr
	Hr	Hr	Mi^2	In		In	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs
1[1]	1.50	2.25	0.30	6	65	2.35	4	7	10	19	55	105	136
2[1]	1.25	2.25	0.20	6	70	2.80	4	6	10	19	56	99	109
3	0.50	2.00	0.10	6	75	3.28	4	10	19	47	89	71	39
4	0.75	2.00	0.25	6	70	2.80	8	16	27	68	176	165	107
5	1.50	0.75	0.20	6	75	3.28	34	103	127	144	119	80	54
6	1.50	0.75	0.40	6	70	2.80	58	176	217	245	204	137	92
7	1.25	0.00	0.20	6	75	3.28	173	144	116	84	53	37	28
Total (Composite hydrograph at end of subarea 7)							285	462	526	626	752	694	565

Future conditions

Sub-area	T_c	T_t	Drainage area	Rain-fall	CN	Run-off	12.5 hr	13.0 hr	13.2 hr	13.5 hr	14.0 hr	14.5 hr	15.0 hr
	Hr	Hr	Mi^2	In		In	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs	Cfs
1[1]	1.50	1.75	0.30	6	65	2.35	7	17	27	53	107	137	122
2[1]	1.25	1.75	0.20	6	70	2.80	6	17	28	54	102	114	90
3	0.50	1.50	0.10	6	75	3.28	8	42	70	97	73	38	21
4	0.75	1.50	0.25	6	70	2.80	13	58	103	188	174	106	60
5	1.50	0.50	0.20	6	85	4.31	81	176	193	184	131	85	59
6	1.00	0.50	0.40	6	75	3.28	234	371	333	245	138	85	62
7	0.75	0.00	0.20	6	90	4.85	315	138	104	73	49	38	32
Total (Composite hydrograph at end of subarea 7)							664	819	858	894	774	603	446

[1]Discharges for these areas are computed from interpolated csm/in (cubic feet per second per square mile per inch of runoff) values from table 5-3.

Graphical Method of Determining Peak Discharge

The curve of T_c vs. peak discharge in csm per inch of runoff shown in figure 5-2 was developed from table 5-3 for zero T_t. It can be used for a watershed where the runoff can be represented by one curve number, i.e., the land use, soils, and cover are similar and are distributed uniformly throughout the watershed. This procedure is limited to peak discharge determination (hydrograph not required) for a watershed where valley routing is not required. The peak discharge can be calculated from figure 5-2 using T_c in hours, runoff in inches from a 24-hour rainfall, and drainage area in square miles.

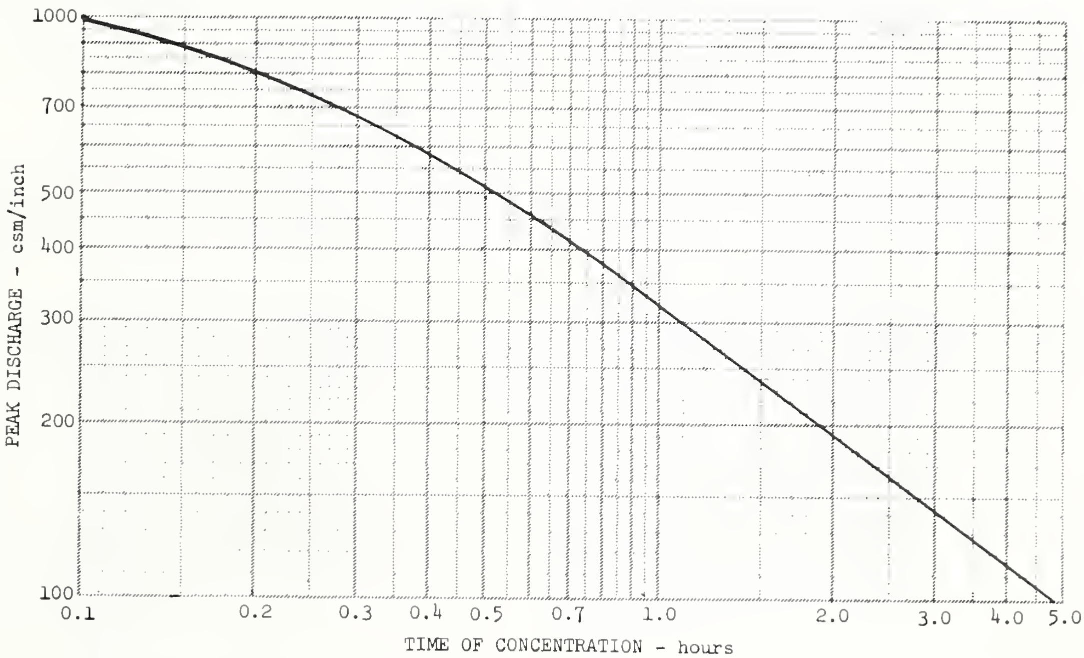

Figure 5-2.--Peak discharge in csm per inch of runoff versus time of concentration (T_c) for 24-hour, type-II storm distribution.

Example 5-2

A developer wishes to install a planned unit development in the uppermost part of a watershed. An ordinance in the township requires that a planned unit development not increase the 100-year-frequency flood flow at the downstream end of the development. The following basic data have been determined for present and future conditions:

Drainage area = 960 acres (1.5 mi^2)

CN (present) = 80

CN (future) = 85

T_c (present) = 0.9 hr

T_c (future) = 0.6 hr

P_{24} (24-hour, 100-year frequency rainfall) = 6.0 in.

The land use (present and future) and hydrologic soil groups are evenly distributed, i.e., runoff characteristics are uniform throughout the watershed. What will be the effect of the planned development on runoff and peak discharge at the 100-year frequency?

1. Present condition:
   $Q = 3.78$ inches for $CN = 80$ and $P_{24} = 6.0$ inches (table 2-1).
   From figure 5-2 for $T_c = 0.9$ hours, $q_p = 345$ csm per inch of runoff.

   $$q = q_p AQ = 345 (1.5) (3.78) = 1,956 \text{ cfs}$$

2. Future condition:
   $Q = 4.31$ inches for $CN = 85$ and $P_{24} = 6.0$ inches (table 2-1).
   From figure 5-2 for $T_c = 0.6$ hours, $q_p = 460$ csm per inch of runoff.

   $$q = q_p AQ = 460 (1.5) 4.31 = 2,974 \text{ cfs}$$

3. The proposed project will increase the total volume of runoff by 14 percent and decrease the time of concentration by 33 percent resulting in an increase in peak discharge of 52 percent (from 1,956 cfs to 2,974 cfs).

Methods described in chapter 7 can be used to determine the reservoir storage capacity required to reduce the peak from 2,974 to 1,956 cfs.

Table 5-3.--Tabular discharges for type-II storm distribution (csm/in) Sheet 1 of 5

TIME OF CONCENTRATION = 0.1 hours
Hydrograph Time in Hours

T_t	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	24	51	299	991	746	477	233	152	132	121	111	85	74	70	68	65	52	48	39	33	29	24	18	14
0.25	20	38	66	140	327	626	686	546	364	236	169	137	117	97	83	75	66	52	41	35	30	24	18	14
0.50	15	27	36	43	67	133	288	482	580	543	429	310	222	168	134	110	81	63	47	38	32	26	19	15
0.75	12	20	25	29	34	42	65	125	245	392	496	515	452	360	273	206	127	80	53	42	35	27	19	15
1.00	9	15	19	21	24	28	32	41	63	115	209	328	427	470	451	389	245	121	64	47	38	29	20	16
1.50	6	10	12	13	14	16	17	19	22	25	29	38	56	92	154	236	410	360	133	66	47	33	21	16
2.00	3	6	7	8	9	10	11	12	13	14	16	18	20	23	27	34	74	244	371	142	68	38	23	17
2.50	2	4	4	5	5	6	7	7	8	9	10	11	12	13	15	16	21	41	243	343	150	48	26	19
3.00	1	2	2	3	3	4	4	4	5	5	6	7	7	8	9	10	12	17	50	239	321	74	29	20
3.50	0	1	1	1	1	2	2	2	3	3	4	4	4	5	6	6	7	10	17	59	304	159	33	21
4.00	0	0	0	0	0	1	1	1	1	2	2	2	2	3	3	4	5	6	10	18	67	290	39	23

TIME OF CONCENTRATION = 0.2 hours
Hydrograph Time in Hours

T_t	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	23	47	208	509	796	641	424	245	170	138	121	104	85	75	71	68	56	49	40	34	29	24	18	14
0.25	18	34	49	91	196	419	603	627	486	341	235	173	138	114	96	83	70	55	43	36	31	25	18	15
0.50	14	24	32	37	50	87	181	341	490	545	497	397	296	219	167	133	92	67	49	39	33	26	19	15
0.75	11	18	23	26	30	36	49	84	161	284	409	491	481	422	340	263	157	89	56	43	36	27	19	15
1.00	9	14	18	20	22	25	29	35	48	79	143	240	347	426	452	427	299	147	69	49	39	29	20	16
1.50	5	9	11	12	13	14	16	18	20	23	26	32	43	67	110	176	330	399	159	72	50	33	22	17
2.00	3	6	7	7	8	9	10	11	12	13	15	16	18	21	24	29	56	192	363	168	75	40	24	18
2.50	1	3	4	5	5	6	6	7	7	8	9	10	11	12	13	15	19	33	200	337	174	51	26	19
3.00	0	2	2	2	3	3	4	4	5	5	6	6	7	8	8	9	11	15	40	203	316	82	29	20
3.50	0	0	1	1	1	2	2	2	2	3	3	4	4	5	5	6	7	9	16	46	300	180	34	22
4.00	0	0	0	0	0	1	1	1	1	1	2	2	2	3	3	3	4	6	9	16	53	286	41	24

Table 5-3.--Tabular discharges for type-II storm distribution (csm/in)--Continued Sheet 2 of 5

TIME OF CONCENTRATION = 0.3 hours

Hydrograph Time in Hours

T_t	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	21	43	141	324	586	658	535	372	251	184	148	124	102	86	77	71	61	51	41	34	30	24	18	14
0.25	17	31	43	67	134	279	461	559	530	428	318	234	179	143	116	97	76	59	45	37	32	25	18	15
0.50	13	22	29	34	42	65	124	238	378	479	499	447	363	281	216	168	110	74	51	41	34	26	19	15
0.75	10	17	21	24	27	32	41	63	114	203	316	413	457	443	389	319	198	105	60	45	37	28	20	15
1.00	8	13	16	18	20	23	26	31	40	60	103	176	269	358	415	426	344	182	77	51	41	30	20	16
1.50	5	8	10	11	12	13	15	16	18	21	24	28	36	52	82	132	272	382	192	81	52	34	22	17
2.00	3	5	6	7	8	8	9	10	11	12	14	15	17	19	21	25	44	151	351	198	85	41	24	18
2.50	1	3	4	4	5	5	6	6	7	8	8	9	10	11	12	14	17	28	162	328	200	54	27	19
3.00	0	1	2	2	3	3	3	4	4	5	5	6	6	7	8	9	10	14	33	169	309	94	30	20
3.50	0	0	1	1	1	1	2	2	2	3	3	3	4	4	5	5	6	9	14	38	172	294	35	22
4.00	0	0	0	0	0	0	1	1	1	1	1	2	2	2	3	3	4	5	9	15	43	281	42	24

TIME OF CONCENTRATION = 0.4 hours

Hydrograph Time in Hours

T_t	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	20	39	103	224	419	558	575	451	331	247	190	155	127	105	90	80	66	53	42	35	30	24	18	14
0.25	15	28	38	54	98	196	343	467	508	464	380	295	228	180	145	119	87	64	47	38	32	26	19	15
0.50	12	20	26	30	37	53	92	172	286	395	462	453	402	332	266	211	137	84	54	42	35	27	19	15
0.75	10	16	19	22	25	29	36	51	85	150	242	338	407	429	406	356	241	128	65	47	38	29	20	16
1.00	8	12	15	17	19	21	24	28	34	49	78	132	208	292	362	403	368	220	88	55	42	30	21	16
1.50	5	8	9	10	11	12	14	15	17	19	22	25	31	43	65	102	220	365	224	93	56	35	22	17
2.00	3	5	6	6	7	8	9	9	10	11	13	14	16	17	20	23	37	119	338	225	99	43	24	18
2.50	1	3	3	4	4	5	5	6	6	7	8	9	10	11	12	13	16	25	132	317	225	58	27	19
3.00	0	1	2	2	2	3	3	3	4	4	5	5	6	7	7	8	10	13	28	140	300	107	31	21
3.50	0	0	1	1	1	1	1	2	2	2	3	3	3	4	4	5	6	8	13	32	146	286	36	22
4.00	0	0	0	0	0	0	0	1	1	1	1	1	2	2	2	3	3	5	8	14	36	275	44	24

Table 5-3.--Tabular discharges for type-II storm distribution (csm/in)--Continued   Sheet 3 of 5

TIME OF CONCENTRATION = 0.5 hours
Hydrograph Time in Hours

T_t	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	18	36	80	166	301	433	496	474	395	309	242	194	158	130	109	94	75	57	43	36	31	25	18	15
0.25	15	26	37	52	94	172	277	372	425	424	383	326	270	221	182	150	107	73	49	39	33	26	19	15
0.50	12	20	25	30	38	58	101	169	252	327	374	385	366	329	285	241	169	103	59	44	36	27	19	15
0.75	9	15	19	22	25	30	41	63	103	162	229	292	335	354	348	325	255	157	77	50	39	29	20	16
1.00	7	12	15	17	19	21	25	31	43	66	103	153	210	264	304	327	317	231	109	61	44	31	21	16
1.50	5	8	9	10	11	12	14	15	17	20	24	31	43	63	92	129	214	295	224	115	65	36	23	17
2.00	3	5	6	6	7	8	9	10	11	12	13	14	16	19	23	30	58	143	271	216	120	46	25	18
2.50	1	3	3	4	4	5	5	6	7	7	8	9	10	11	12	14	18	39	150	253	209	71	28	19
3.00	0	1	2	2	2	3	3	4	4	4	5	5	6	7	7	8	10	15	48	154	239	126	32	21
3.50	0	0	1	1	1	1	2	2	2	2	3	3	4	4	5	5	6	8	16	56	155	227	38	23
4.00	0	0	0	0	0	1	1	1	1	1	1	2	2	2	3	3	4	5	9	19	63	217	52	25

TIME OF CONCENTRATION = 0.75 hours
Hydrograph Time in Hours

T_t	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	15	29	57	98	163	248	329	375	388	369	325	276	232	195	165	142	107	76	51	39	33	26	19	15
0.25	12	21	29	39	61	100	158	227	291	336	355	348	321	285	247	212	156	103	62	44	36	27	19	15
0.50	10	16	21	24	29	41	63	100	150	208	263	305	327	329	314	288	226	147	79	52	40	29	20	16
0.75	8	13	16	18	20	24	30	43	65	98	142	192	239	278	303	311	286	208	107	63	45	31	21	16
1.00	6	10	13	14	15	17	20	24	31	44	65	95	134	177	220	256	294	264	149	81	53	33	21	16
1.50	4	6	8	9	10	11	12	13	14	16	19	23	31	42	60	83	147	269	248	152	85	40	23	17
2.00	2	4	5	5	6	7	7	8	9	10	11	12	14	16	18	23	39	97	251	235	153	56	26	19
2.50	1	2	3	3	4	4	4	5	5	6	7	7	8	9	10	11	15	28	107	218	236	91	29	20
3.00	0	1	1	2	2	2	2	3	3	4	4	5	5	6	6	7	8	12	33	113	225	153	34	22
3.50	0	0	1	1	1	1	1	1	2	2	2	3	3	3	4	4	5	7	13	39	117	215	44	24
4.00	0	0	0	0	0	0	0	1	1	1	1	1	1	2	2	2	3	4	7	15	45	207	63	26

Table 5-3.--Tabular discharges for type-II storm distribution (csm/in)--Continued Sheet 4 of 5

TIME OF CONCENTRATION = 1.0 hours

Hydrograph Time in Hours

T_t	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	13	24	45	66	107	155	211	258	301	313	316	301	277	247	217	188	146	102	64	46	36	27	19	15
0.25	10	18	24	32	45	68	102	146	193	238	272	293	299	293	275	252	200	139	81	54	41	29	20	16
0.50	8	14	17	20	24	32	46	68	99	136	178	219	251	274	284	283	254	187	105	65	47	31	21	16
0.75	7	11	13	15	17	20	25	33	46	67	94	128	165	202	233	256	273	236	140	82	55	33	21	16
1.00	5	9	11	12	13	15	17	20	25	33	46	65	90	121	154	187	240	262	183	107	66	37	22	17
1.50	3	5	7	7	8	9	10	11	12	14	16	19	24	31	43	58	103	185	244	181	110	48	24	18
2.00	2	3	4	4	5	6	6	7	8	8	9	10	11	13	15	18	29	69	182	230	178	70	27	19
2.50	1	2	2	3	3	3	4	4	5	5	6	6	7	8	9	10	12	21	77	178	219	114	31	21
3.00	0	1	1	1	1	2	2	2	3	3	3	4	4	5	5	6	7	10	25	83	210	172	39	22
3.50	0	0	0	0	1	1	1	1	1	2	2	2	2	3	3	3	4	6	11	29	88	202	52	25
4.00	0	0	0	0	0	0	0	0	1	1	1	1	1	1	2	2	2	4	6	12	33	195	77	28

TIME OF CONCENTRATION = 1.25 hours

Hydrograph Time in Hours

T_t	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	11	21	37	51	79	107	147	187	219	249	264	271	267	256	241	219	177	128	81	56	42	29	20	16
0.25	9	15	21	27	36	53	74	103	137	172	205	231	249	259	259	253	223	167	102	67	48	31	21	16
0.50	7	12	15	17	21	27	37	51	72	98	128	160	190	216	235	247	251	209	130	82	56	34	21	16
0.75	6	9	12	13	15	17	21	27	36	50	69	93	120	149	177	202	235	242	165	103	67	38	22	17
1.00	4	7	9	10	11	13	14	17	21	27	36	49	66	88	113	139	190	236	200	130	83	43	23	17
1.50	3	5	6	6	7	8	8	9	10	12	14	16	20	25	33	44	76	142	223	195	131	58	26	18
2.00	1	3	3	4	4	5	5	6	6	7	8	9	10	11	13	15	24	52	143	212	189	86	29	20
2.50	1	1	2	2	2	3	3	3	4	4	5	5	6	7	7	8	10	17	58	143	201	132	35	21
3.00	0	1	1	1	1	1	2	2	2	2	3	3	3	4	4	5	6	9	20	64	143	196	45	23
3.50	0	0	0	0	0	1	1	1	1	1	1	2	2	2	2	3	4	5	9	23	68	190	62	26
4.00	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	2	3	5	10	26	184	91	30

Table 5-3.--Tabular discharges for type-II storm distribution (csm/in)--Continued   Sheet 5 of 5

TIME OF CONCENTRATION = 1.5 hours

Hydrograph Time in Hours

T_t	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	10	18	31	42	57	81	105	133	164	192	209	227	235	236	236	225	201	153	99	68	50	32	20	16
0.25	8	13	17	22	30	41	57	76	99	125	153	178	199	215	225	230	224	188	122	82	58	36	21	16
0.50	6	10	13	15	18	22	30	40	54	72	94	118	143	167	188	204	224	214	152	99	68	39	22	17
0.75	5	8	10	11	13	15	18	22	29	39	52	69	89	111	134	157	194	219	182	122	82	44	23	17
1.00	4	6	8	9	10	11	12	14	17	22	29	38	50	66	84	105	148	198	214	150	100	50	24	18
1.50	2	4	5	5	6	7	7	8	9	10	12	14	17	21	26	34	58	109	191	204	149	70	28	19
2.00	1	2	3	3	4	4	4	5	5	6	7	8	8	10	11	13	19	40	112	184	197	102	33	20
2.50	0	1	1	2	2	2	3	3	3	4	4	5	5	6	6	7	9	14	45	114	190	147	40	22
3.00	0	0	1	1	1	1	1	1	2	2	2	3	3	3	4	4	5	7	16	49	115	184	53	25
3.50	0	0	0	0	0	0	1	1	1	1	1	1	2	2	2	2	3	4	8	18	53	178	74	28
4.00	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	2	2	4	8	21	174	105	34

TIME OF CONCENTRATION = 2.0 hours

Hydrograph Time in Hours

T_t	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	7	14	22	30	38	49	64	80	95	114	133	152	165	175	184	192	190	176	129	93	68	41	23	17
0.25	6	10	13	17	22	28	37	47	61	75	91	108	126	143	157	168	185	189	153	109	79	46	24	17
0.50	5	8	10	11	13	17	21	27	35	45	57	71	86	103	119	135	162	186	172	129	92	52	26	18
0.75	4	6	8	8	10	11	13	16	21	26	34	43	55	67	82	97	129	166	183	149	109	59	27	18
1.00	3	5	6	7	7	8	9	11	13	16	20	26	33	42	52	64	92	136	180	167	127	68	29	19
1.50	1	3	3	4	4	5	5	6	7	8	9	10	12	15	18	23	37	68	135	175	163	93	34	21
2.00	1	1	2	2	3	3	3	4	4	5	5	6	6	7	8	10	14	26	71	133	170	127	42	23
2.50	0	1	1	1	1	1	2	2	2	3	3	3	4	4	5	5	7	11	29	74	132	166	53	26
3.00	0	0	0	0	1	1	1	1	1	1	2	2	2	2	3	3	4	5	12	32	76	162	71	30
3.50	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	2	2	3	6	13	35	158	95	35
4.00	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	2	3	6	14	80	155	43

CHAPTER 6

SCS-TR-20 METHOD OF DETERMINING PEAK FLOW

Introduction

This chapter presents a general description of the "Computer Program for Project Formulation--Hydrology" distributed by SCS through Technical Release No. 20 (SCS-TR-20). A detailed description of the use of the computer program is beyond the scope of this chapter. However, an awareness of its potential use in urban hydrologic studies is important. The program was developed primarily as an evaluation tool for watershed project planning. It provides a procedure for analyzing alternative systems of structural measures. SCS-TR-20 describes in detail the preparation of input data.

Areas of Application

Under most conditions seen in the field the hydrologic effects of urbanizing a watershed can be determined by using methods described in chapters 4 and 5. However, consideration should be given to using the computer program when:

1. Watersheds are larger than 2,000 acres
2. There are many subareas with different runoff characteristics
3. Large swamp areas or reservoirs are present
4. Historical storm events need to be analyzed

General Description

The program was developed with strict adherence to a policy of having it (1) as flexible as possible in the use of input data; (2) provide for the maximum use of engineering judgment; (3) engineer-oriented rather than machine-oriented; and (4) described in the FORTRAN system to provide for ease in future extensions, alterations, and recompilation for other computer models.

The program computes surface runoff resulting from any synthetic or natural rainstorm. It takes into account conditions affecting runoff (CN, T_c, etc.), develops a hydrograph, and routes the hydrograph through stream channels and reservoirs. The computer can combine the routed hydrograph with those from other tributaries and print out the total composite hydrograph, peak discharges, time of occurrence, and the water surface elevation at each desired cross section or structure. Watersheds are analyzed under present conditions and with various combinations of land treatment, floodwater-retarding structures, and channel improvement.

Capabilities and Limitations

In general, in any one continuous operation, the computer program can:

1. Route through as many as 60 structures and an unlimited number of variations for each structure, including that of having no structure.

2. Route through as many as 120 stream reaches and an unlimited number of channel modifications for each reach.

3. Compute up to 300 ordinates of a hydrograph and print out the discharge and elevation for each.

4. Make an unlimited number of routings through a watershed, including variations in rainfall amounts, rainfall duration, and antecedent moisture condition.

5. Develop and route the runoff for nine different storm distributions and for an unlimited number of depths and durations for any storm distribution.

6. Combine hydrographs from an unlimited number of tributaries and reaches.

Hydrologic and hydraulic parameters that are affected by urbanization can be varied and used as input to the computer program and the effects can be analyzed.

If it is desired to use the computer program for urban hydrology studies, a copy of SCS-TR-20 can be obtained from any SCS state office. A copy of the source program can be obtained by SCS personnel through the SCS Management Division, Washington, D.C.; other users can obtain a copy through the National Technical Information Service:

National Technical Information Service
U.S. Department of Commerce
P.O. Box 1553
Springfield, Virginia 22151

CHAPTER 7

METHODS FOR CONTROLLING PEAK DISCHARGES FROM URBANIZING AREAS

Introduction

As rural areas urbanize, the increase in peak discharges due to more efficient conveyance paths and increased impervious areas can have a significant adverse impact on downstream areas. There is a growing interest on the part of planners, developers, and the public in protecting downstream areas from induced flood damages that may accompany increased peaks and stages. Planning authorities are proposing local ordinances that restrict the type of development permitted and the impact development can have on the watershed. One of the primary controls being imposed is that future-condition discharges cannot exceed present-condition discharges at some predetermined frequency of occurrence at specified points on the channel.

Earlier chapters discussed methods of determining changes in peak discharges. This chapter discusses types of measures or construction techniques that can be used to control peak discharges from urbanizing areas through planned runoff delay and increased infiltration and presents a procedure for estimating the amount of storage required to maintain peaks at some predetermined level.

Methods of Reducing or Delaying Urban Runoff

Methods to control runoff in urbanizing areas reduce either the volume or the rate of runoff. The effectiveness of any control method depends on the available storage, the outflow rate, and the inflow rate. Because a great variety of methods can be used to control peak flows, each method proposed should be evaluated for its effectiveness in the given area.

Table 7-1 lists measures for reducing and delaying urban storm runoff. Table 7-2 lists some advantages and disadvantages of each measure. Both tables were adapted from tables prepared at Pennsylvania State University under the direction of Gert Aron, associate professor of civil engineering. Effective measures for reducing peak rates of runoff are, of course, not limited to those listed in table 7-1.

Effects of Reducing or Delaying Urban Runoff

The direct reduction of peak flows and volume of runoff through installation of these measures is very difficult to determine. Measures that increase infiltration also reduce runoff. Therefore the runoff curve number will be lower than it would be without the measures. Measures that delay runoff also increase the time of concentration. The degree of change in curve number or time of concentration over the watershed depends on how extensively each measure is applied.

Table 7-1.--Measures for reducing and delaying urban storm runoff

Area	Reducing runoff	Delaying runoff
Large flat roof	1. Cistern storage 2. Rooftop gardens 3. Pool storage or fountain storage 4. Sod roof cover	1. Ponding on roof by constricted downspouts 2. Increasing roof roughness a. Rippled roof b. Gravelled roof
Parking lots	1. Porous pavement a. Gravel parking lots b. Porous or punctured asphalt 2. Concrete vaults and cisterns beneath parking lots in high value areas 3. Vegetated ponding areas around parking lots 4. Gravel trenches	1. Grassy strips on parking lots 2. Grassed waterways draining parking lot 3. Ponding and detention measures for impervious areas a. Rippled pavement b. Depressions c. Basins
Residential	1. Cisterns for individual homes or groups of homes 2. Gravel driveways (porous) 3. Contoured landscape 4. Ground-water recharge a. Perforated pipe b. Gravel (sand) c. Trench d. Porous pipe e. Dry wells 5. Vegetated depressions	1. Reservoir or detention basin 2. Planting a high delaying grass (high roughness) 3. Gravel driveways 4. Grassy gutters or channels 5. Increased length of travel of runoff by means of gutters, diversions, etc.
General	1. Gravel alleys 2. Porous sidewalks 3. Mulched planters	1. Gravel alleys

Table 7-2.--Advantages and disadvantages of measures for reducing and delaying runoff

Measure	Advantages	Disadvantages
A. Cisterns and covered ponds	1. Water may be used for: a. Fire protection b. Watering lawns c. Industrial processes d. Cooling purposes 2. Reduce runoff while only occupying small area 3. Land or space above cistern may be used for other purposes	1. Expensive to install 2. Cost required may be restrictive if the cistern must accept water from large drainage areas 3. Requires slight maintenance 4. Restricted access 5. Reduced available space in basements for other uses
B. Rooftop gardens	1. Esthetically pleasing 2. Runoff reduction 3. Reduce noise levels 4. Wildlife enhancement	1. Higher structural loadings on roof and building 2. Expensive to install and maintain
C. Surface pond storage (usually residential areas)	1. Controls large drainage areas with low release 2. Esthetically pleasing 3. Possible recreation benefits a. Boating b. Ice skating c. Fishing d. Swimming 4. Aquatic life habitat 5. Increases land value of adjoining property	1. Require large areas 2. Possible pollution from storm water and siltation 3. Possible mosquito breeding areas 4. May have adverse algal blooms as a result of eutrophication 5. Possible drowning 6. Maintenance problems
D. Ponding on roof by constricted downspouts	1. Runoff delay 2. Cooling effect for building a. Water on roof b. Circulation through 3. Roof ponding provides fire protection for building (roof water may be tapped in case of fire)	1. Higher structural loadings 2. Clogging of constricted inlet requiring maintenance 3. Freezing during winter (expansion) 4. Waves and wave loading 5. Leakage of roof water into building (water damage)

Table 7-2.--Advantages and disadvantages of measures for reducing and delaying runoff--Continued

Measure	Advantages	Disadvantages
E. Increased roof roughness a. Rippled roof b. Gravel on roof	1. Runoff delay and some reduction (detention in ripples or gravel)	1. Somewhat higher structural loadings
F. Porous pavement (parking lots and alleys) a. Gravel parking lot b. Holes in impervious pavements (1/4 in. ϕ) filled with sand	1. Runoff reduction (a and b) 2. Potential ground-water recharge (a and b) 3. Gravel pavements may be cheaper than asphalt or concrete (a)	1. Clogging of holes or gravel pores (a and b) 2. Compaction of earth below pavement or gravel decreases permeability of soil (a and b) 3. Ground-water pollution from salt in winter (a and b) 4. Frost heaving for impervious pavement with holes (b) 5. Difficult to maintain 6. Grass or weeds could grow in porous pavement (a and b)
G. Grassed channels and vegetated strips	1. Runoff delay 2. Some runoff reduction (infiltration recharge) 3. Esthetically pleasing a. Flowers b. Trees	1. Sacrifice some land area for vegetated strips 2. Grassed areas must be mowed or cut periodically (maintenance costs)
H. Ponding and detention measures on impervious pavement a. Rippled pavement b. Basins c. Constricted inlets	1. Runoff delay (a, b, and c) 2. Runoff reduction (a and b)	1. Somewhat restricted movement of vehicle (a) 2. Interferes with normal use (b and c) 3. Damage to rippled pavement during snow removal (a) 4. Depressions collect dirt and debris (a, b, and c)

Table 7-2.--Advantages and disadvantages of measures for reducing and delaying runoff--Continued

Measure	Advantages	Disadvantages
I. Reservoir or detention basin	1. Runoff delay 2. Recreation benefits a. Ice skating b. Baseball, football, etc., if land is provided 3. Esthetically pleasing 4. Could control large drainage areas with low release	1. Considerable amount of land is necessary 2. Maintenance costs a. Mowing grass b. Herbicides c. Cleaning periodically (silt removal) 3. Mosquito breeding area 4. Siltation in basin
J. Converted septic tank for storage and ground-water recharge	1. Low installation costs 2. Runoff reduction (infiltration and storage) 3. Water may be used for: a. Fire protection b. Watering lawns and gardens c. Ground-water recharge	1. Requires periodic maintenance (silt removal) 2. Possible health hazard 3. Sometimes requires a pump for emptying after storm
K. Ground-water recharge a. Perforated pipe or hose b. French drain c. Porous pipe d. Dry well	1. Runoff reduction (infiltration) 2. Ground-water recharge with relatively clean water 3. May supply water to garden or dry areas 4. Little evaporation loss	1. Clogging of pores or perforated pipe 2. Initial expense of installation (materials)
L. High delay grass (high roughness)	1. Runoff delay 2. Increased infiltration	1. More difficult to mow
M. Routing flow over lawn	1. Runoff delay 2. Increased infiltration	1. Possible erosion or scour 2. Standing water on lawn in depressions

Preliminary studies at Pennsylvania State University[1] have shown that for one particular situation analyzed (a 200-acre urban watershed) the potential peak flow was reduced by about 8 percent by gravel minidikes on slightly slanted roofs. Also, installing grass-protected infiltration trenches to control runoff from parking lots reduced the flood peak by about 5 percent. Various possible combinations of methods should be evaluated on their particular merit for the watershed under consideration.

Methods for Estimating the Effect of Storage

When a structure such as a retarding dam or holding pond is installed, hydraulic routing procedures can be used to determine the effect on peak discharges. The SCS-TR-20 program referred to in chapter 6 provides an accurate method for analyzing this situation. A less accurate method has been developed for quickly analyzing effects of storage reservoirs on peak discharges. The method is based on average storage and routing effects for many structures. The storage indication method of routing was used. Figure 7-1 relates the volume of inflow to volume of required storage for a range of peak release rates. Figure 7-2 relates the peak outflow-inflow ratio to the storage-runoff volume ratio where a single-stage pipe spillway or weir is used. Emergency spillway flow is not considered.

The accuracy of the curves in figures 7-1 and 7-2 depends on the relationship between the storage available, the inflow volume, and the shape of the inflow hydrograph. When only a small volume is available for temporary storage, the shape of the outflow hydrograph is very sensitive to the rate of rise of the inflow hydrograph. Conversely, when a large volume is available for storage, the shape of the inflow hydrograph has little effect on the outflow hydrograph which, in this case, is controlled by the hydraulics of the structural system. Therefore, parameters such as runoff curve number and time of concentration, which affect the rate of rise of a hydrograph, become significant parameters in analyzing the effects of structures when the peak outflow rate approaches the peak inflow rate.

In figure 7-1 the peak inflow rate is not a factor in determining storage requirements. It can be seen that the ratio of volume of storage (V_s) to volume of runoff (V_r) is relatively high. Therefore, inflow peak is not a significant parameter. Figure 7-1 is usually accurate within 5 percent for release rates under 100 csm (cubic feet per second per square mile) and within 10 percent for release rates over 100 csm.

Figure 7-2 relates the ratio of peaks to volumes. For this case the parameters affecting the shape of the hydrograph are important. In situations where runoff curve numbers are less than 65 in combination with short T_c values, V_s/V_r values read from the curve will be up to 25 percent too high. Runoff curve numbers over 85 with long T_c values cause V_s/V_r values to be up to 25 percent too low.

[1]Studies of flood peak abatement in urban storm runoff conducted by Gert Aron, assoc. prof. civil eng., Pennsylvania State Univ.

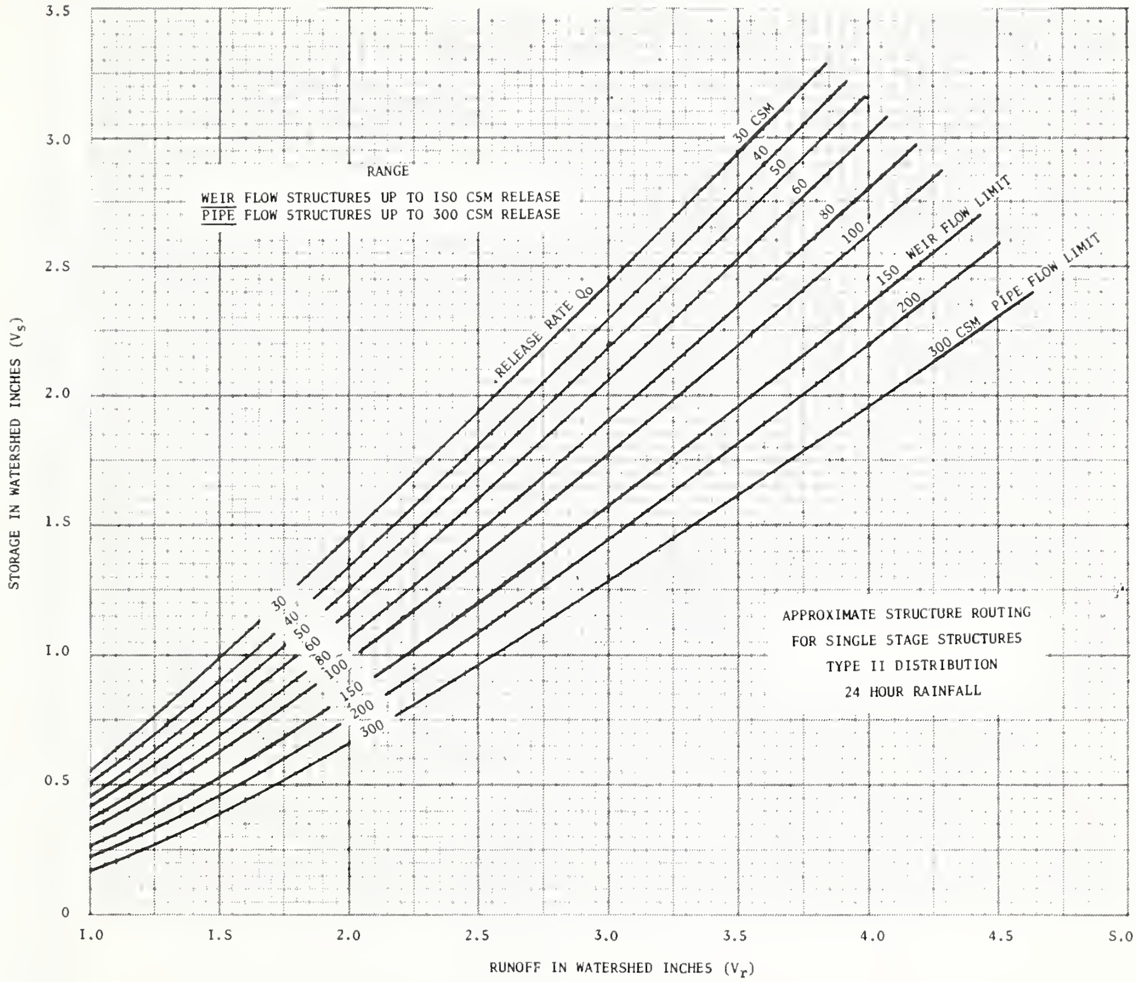

Figure 7-1.--Approximate single-stage structure routing for weir flow structures up to 150 csm release rate and pipe flow structures up to 300 csm release rate.

Figure 7-1 applies to pipe drop inlets of 0 to 300 csm release rate and weir flow structures of 0 to 150 csm release rate. Figure 7-2 applies to pipe drop inlets of over 300 csm release rate and weir flow structures of over 150 csm release rate.

Extrapolation for points falling outside the limits of the curves could introduce a significant error. The steps necessary to use the procedure described in this chapter are:

1. Determine the basic watershed parameters (DA, CN, T_c, etc.).

2. Determine the volume of runoff and peak rate of flow from the watershed.

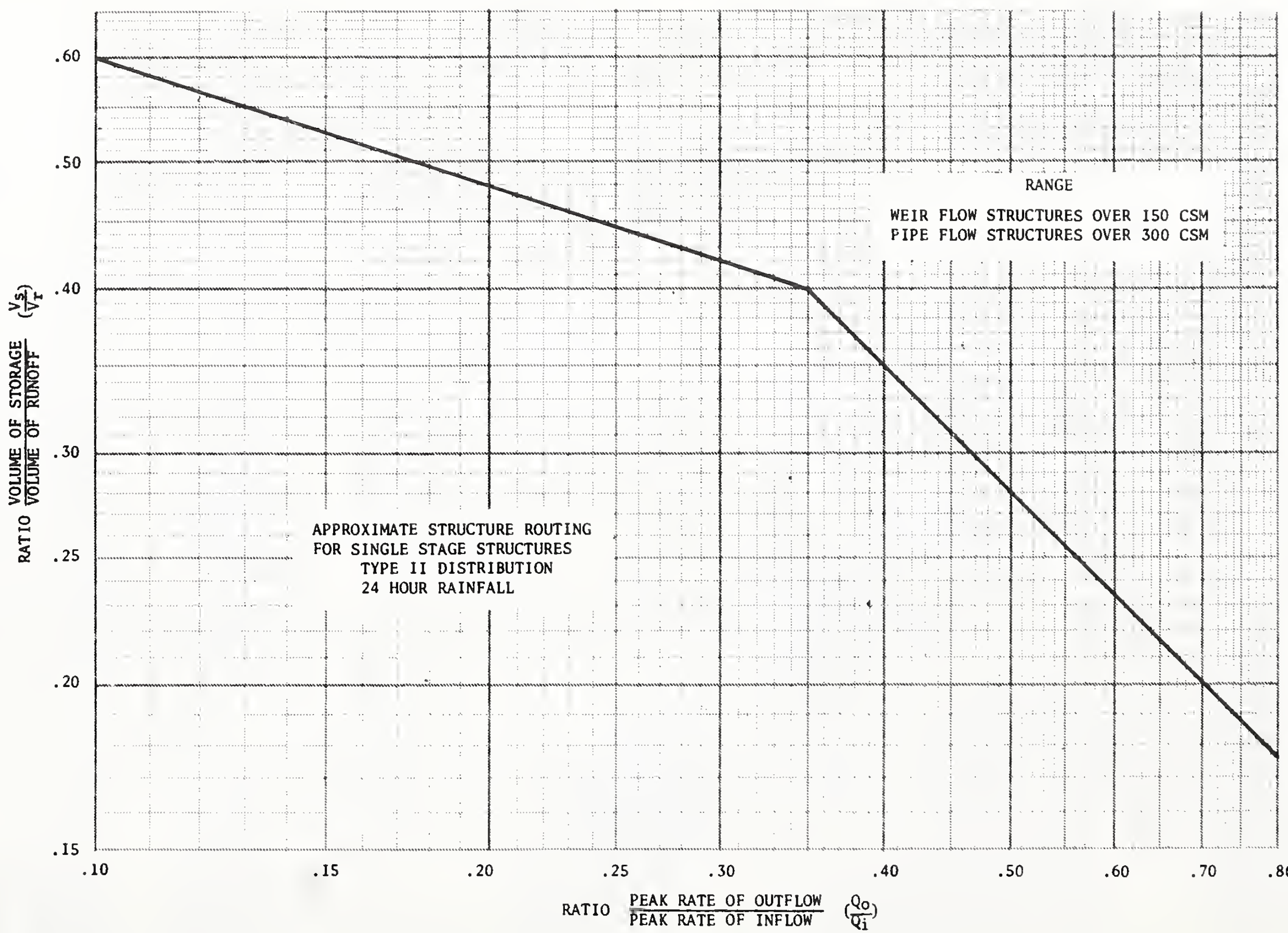

Figure 7-2.--Approximate single-stage structure routing for weir flow structures over 150 csm release rate and pipe flow structures over 300 csm release rate.

3. Set the desired rate of outflow from the structure.

4. Determine the required volume of storage from the appropriate figure, 7-1 or 7-2.

5. Proportion the storage structure so that the design outflow rate and maximum storage occur at the same stage.

Note that in steps 3 and 4, the storage volume could be set and the resulting rate of outflow determined from figures 7-1 and 7-2. For structures with drainage areas over 2,000 acres and for events of less than 2-year frequency, the SCS-TR-20 program discussed in chapter 6 should be used. The following examples show how figures 7-1 and 7-2 are used.

Example 7-1

A developer is attempting to secure a permit to install a 4.2-acre-ft detention reservoir at the outlet of a proposed 75-acre development for storm water management. Based on procedures described in chapter 4, the present peak discharge of the design storm is 180 cfs (cubic feet per second), the future runoff is 3.4 inches, and the future peak discharge is 360 cfs. Using the stage-discharge and stage-storage curves shown in figure 7-3, determine whether the proposed structure will reduce the future-condition peak discharge to 180 cfs.

For this example, 180 cfs is the desired outflow Q_o and 360 cfs is the future-condition discharge into the reservoir Q_i. Inflow runoff V_r is 3.4 inches.

1. Select the proper figure to use in the shortcut routing method.

$$Q_o = 180 \text{ cfs (present peak)}$$

$$= \frac{180 \text{ cfs } (640 \text{ acres/mi}^2)}{75 \text{ acres}} = 1{,}536 \text{ csm}$$

Since Q_o is greater than 300 csm, use figure 7-2.

2. Compute $\frac{Q_o}{Q_i}$ (must be in same units).

$$\frac{Q_o}{Q_i} = \frac{180 \text{ cfs}}{360 \text{ cfs}} = 0.5$$

3. Determine V_s (volume storage).

With $\frac{Q_o}{Q_i} = 0.5$, enter figure 7-2 and find $\frac{V_s}{V_r} = 0.28$.

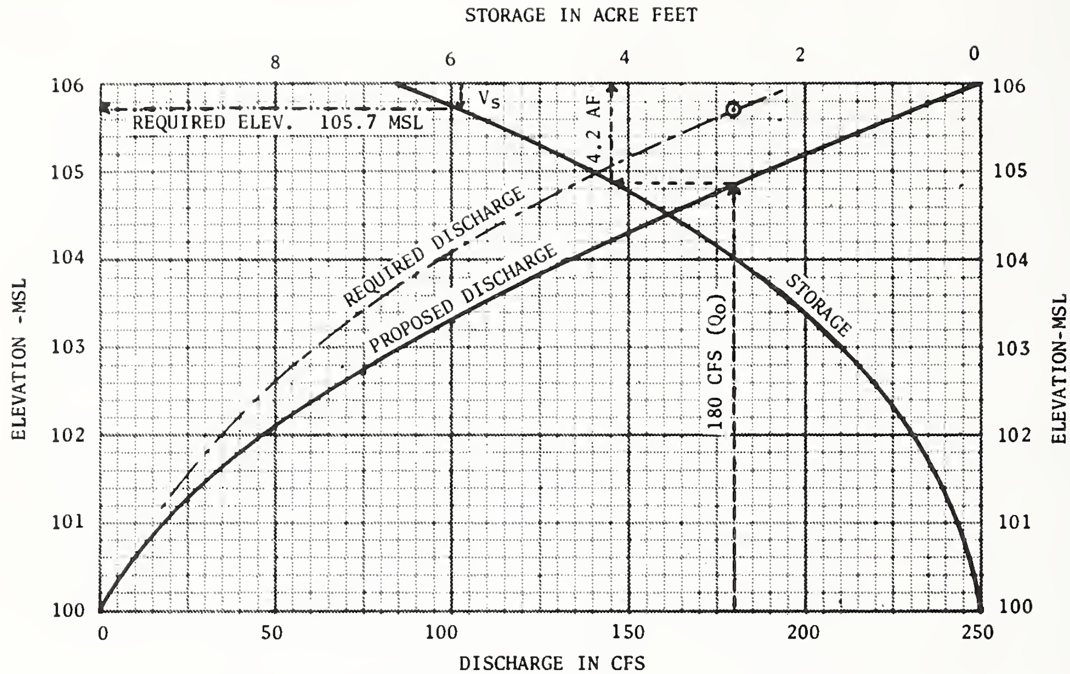

Figure 7-3.--Stage-discharge and stage-storage relationship for structure A in example 7-1.

Since V_r = 3.4 inches, then

$$V_s = 0.28\ (3.4) = 0.95 \text{ in}$$

$$= \frac{0.95 \text{ in } (75 \text{ acres})}{12 \text{ in/ft}} = 5.9 \text{ acre-ft}$$

4. Determine available storage.
   From figure 7-3 the elevation of the crest of the emergency spillway must be 104.8 msl (mean sea level) to discharge 180 cfs. At this elevation the available storage is 4.2 acre-ft.

5. Evaluate proposed structure.
   The required storage of 5.9 acre-ft is greater than the 4.2 acre-ft provided by the proposed structure. The structure should be redesigned to raise the crest of the emergency spillway to 105.7 msl (5.9 acre-ft), and the principal spillway should be modified so that it will discharge 180 cfs at 105.7 msl.

<u>Example 7-2</u>
Based on the conditions in example 5-1, determine the release rate and the storage required at structure 6A located near the outlet of subarea 6 to maintain the peak discharge at the existing rate at the outlet of

the watershed. Refer to figure 5-1 and tables 5-1 and 5-2. Assume a pipe drop inlet spillway for the structure.

1. From table 5-2, subtract the future-condition flow contribution by subarea 6 from the future composite hydrograph as follows:

Hydrograph location	Time (hours) 13.0	13.2	13.5	14.0	14.5
Composite discharge (cfs)	819	858	894	774	603
Subarea 6 discharge (cfs)	371	333	245	138	85
Composite discharge minus subarea 6 (cfs)	448	525	649	636	518

   Note that the partial composite hydrograph peak is 649 cfs at the outlet of the watershed.

2. Since the present-condition maximum peak discharge at the outlet is 752 cfs, the release rate of structure 6A cannot exceed 752 cfs minus the peak of the partial composite hydrograph. Therefore,

$$\text{maximum release rate} = 752 - 649 = 103 \text{ cfs}$$

3. Determine peak outflow (Q_o) in csm from proposed structure 6A.

$$Q_o = \frac{103 \text{ cfs}}{0.4 \text{ mi}^2} = 258 \text{ csm}$$

4. A pipe drop inlet with 258 csm maximum release rate will be routed. Use figure 7-1 since the release rate is less than 300 csm.

5. Determine required storage (V_s). With Q_o = 258 csm, V_r = 3.28 in. (future-condition runoff for subarea 6). Enter figure 7-1 and find

$$V_s = 1.55 \text{ in}$$

$$= \frac{1.55 \text{ in } (640 \text{ acres/mi}^2)(0.4 \text{ mi}^2)}{12 \text{ in/ft}} = 33.1 \text{ acre-ft}$$

   Therefore, the storage required to maintain the peak discharge at the present rate at the watershed outlet is 1.55 inches or 33.1 acre-ft. The pipe spillway must be designed to provide 103 cfs outflow at 33.1-acre-ft storage.

Example 7-3

Determine the release rates and storage required to maintain present peaks for two structures, one located at the outlet of subarea 4 (site 4A) and one at the outlet of subarea 6 (site 6A) as shown in figure 5-1 and example 5-1. Structure 4A will have a pipe drop inlet spillway and structure 6A will have a straight drop spillway.

1. The decision on the amount of reduction to be accomplished at each structure is more or less arbitrary. Several alternatives should be studied to find the optimum design. This example will illustrate one trial calculation to show the procedure used. First subtract future-condition outflows of subareas 4 and 6 from the future composite hydrograph as follows:

Hydrograph location	Time (hours) 13.00	13.20	13.50	14.00	14.50
Composite discharge (cfs)	819	858	894	774	603
Subarea 4 discharge (cfs)	58	103	188	174	106
Subarea 6 discharge (cfs)	371	333	245	138	85
Composite discharge minus subareas 4 and 6 (cfs)	390	422	461	462	412

Note that the partial composite hydrograph peak discharge is 462 cfs.

2. The combined release rates of the two structures can be 752 cfs (desired peak) less 462 cfs (partial composite peak). Therefore structure 4A release and structure 6A release equals 752 minus 462, or 290 cfs.

3. It is now necessary to decide the distribution of the 290 cfs release rate between the two structures. For a first trial assume structure 6A release is 200 cfs and structure 4A release is 90 cfs.

4. Determine storage required in structure 6A.

   a. $Q_o = 200 \text{ cfs} = \dfrac{200 \text{ cfs}}{0.4 \text{ mi}^2} = 500 \text{ csm}.$
      Since Q_o is more than 300 csm, use figure 7-2.

   b. Since figure 7-2 is to be used, the peak inflow (Q_i) at the outlet of subarea 6 must be determined.

      <u>Do not use 371 cfs or 245 cfs</u>, because the discharges in table 5-2 and in step 1 above are subarea contributions at the outlet of subarea 7 and not the peak inflow at subarea 6.

      Enter table 5-3 for T_c = 1.00 hr (sheet 4 of 5) and T_t = 0 and find Q_i = 316 csm per inch of runoff.

      $$Q_i = 316\ (V_r) = 316\ (3.28) = 1,036 \text{ csm}$$

   c. Compute required storage (V_s).

      With Q_o = 500 csm and Q_i = 1,036 csm,

      $$\frac{Q_o}{Q_i} = \frac{500}{1,036} = 0.48$$

From figure 7-2, $\frac{V_s}{V_r}$ = 0.29 and with V_r = 3.28 in (future-condition runoff)

$$V_s = 0.29\ (V_r) = 0.29\ (3.28) = 0.95 \text{ in}$$

$$= \frac{0.95 \text{ in } (640 \text{ acres/mi}^2)\ (0.40 \text{ mi}^2)}{12 \text{ in/ft}} = 20 \text{ acre-ft}$$

5. Determine storage required in structure 4A.

   a. Q_o (step 3) = 90 cfs = $\frac{90 \text{ cfs}}{0.25 \text{ mi}^2}$ = 360 csm

      Since Q_o = 360 csm and the outflow structure is a pipe drop inlet, use figure 7-2.

   b. Since figure 7-2 is to be used, the peak inflow (Q_i) at the outlet of subarea 4 must be determined. Enter table 5-3 for T_c = 0.75 and Tt = 0 and find Q_i = 388 csm per inch of runoff.

$$Q_i = 388\ (V_r) = 388\ (2.80) = 1{,}086 \text{ csm}$$

   c. Compute required storage (V_s).

      With Q_o = 360 csm and Q_i = 1,086 csm,

$$\frac{Q_o}{Q_i} = \frac{360}{1{,}086} = 0.33$$

      From figure 7-2 read $\frac{V_s}{V_r}$ = 0.41, and with V_r = 2.80 in,

$$V_s = 0.41\ (2.80) = 1.1 \text{ in}$$

$$= \frac{1.1 \text{ in } (640 \text{ acres/mi}^2)(0.25 \text{ mi}^2)}{12 \text{ in/ft}} = 15 \text{ acre-ft}$$

6. Summary

Structure	Drainage area	Q_o		Storage
	mi^2	csm	cfs	acre-ft
4A	.25	368	90	15
6A	.40	500	200	20
Total	---	---	290	35

Other trial calculations can be made to determine the most economical allocation of storage between the two structures that still maintains a combined release rate of 290 cfs.

APPENDIX A

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APPENDIX B

SOIL SERIES AND HYDROLOGIC SOIL GROUPS

This appendix provides soil names and their hydrologic classification used in determining soil-cover complexes in chapter 2 of this technical release. The hydrologic parameter, A, B, C, or D, is an indicator of the minimum rate of infiltration obtained for a bare soil after prolonged wetting. By using the hydrologic classification and the associated land use, runoff curve numbers can be computed as shown in chapter 2.

The hydrologic soil groups, as defined by SCS soil scientists, are:

A. (Low runoff potential). Soils having a high infiltration rate even when thoroughly wetted and consisting chiefly of deep, well to excessively drained sands or gravels.

B. Soils having a moderate infiltration rate when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse texture.

C. Soils having a slow infiltration rate when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water or soils with moderately fine to fine texture.

D. (High runoff potential). Soils having a very slow infiltration rate when thoroughly wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material.

Table B.1--Soil names and hydrologic classifications

		AKAKA	A	AMADOR	D	ARBOR	B	ATLEE	C
AASTAD	B	AKASKA	B	AMAGON	D	ARBUCKLE	B	ATMORE	B/D
ABAJO	C	AKELA	C	AMALU	D	ARCATA	B	ATOKA	C
ABBOTT	D	ALADDIN	B	AMANA	B	ARCH	B	ATSION	C
ABBOTTSTOWN	C	ALAE	A	AMARGOSA	D	ARCHABAL	B	ATTERBERRY	B
ABEGG	B	ALAELOA	B	AMARILLO	B	ARCHER	C	ATTEWAN	A
ABELA	B	ALAGA	A	AMASA	B	ARCHIN	C	ATTICA	B
ABELL	B	ALAKAI	D	AMBERSON		ARCO	B	ATTLEBORO	
ABERDEEN	D	ALAMA	C	AMBOY	C	ARCOLA	C	ATWATER	B
ABES	D	ALAMANCE	B	AMBRAW	C	ARD	C	ATWELL	C
ABILENE	C	ALAMO	D	AMEDEE	A	ARDEN	B	ATWOOD	B
ABINGTON	B	ALAMOSA	C	AMELIA	B	ARDENVOIR	B	AUBBEENAUBBEE	B
ABIQUA	C	ALAPAHA	D	AMENIA	B	ARDILLA	C	AUBERRY	B
ABO	B	ALAPAI	A	AMERICUS	A	AREDALE	B	AUBURN	C
ABRA	C	ALBAN	B	AMES	C	ARENA	C	AUBURNDALE	D
ABRAHAM	B	ALBANO	D	AMHERST	C	ARENALES	A	AUDIAN	B
ABSAROKEE	C	ALBANY	C	AMITY	C	ARENDTSVILLE	B	AU GRES	C
ABSCOTA	B	ALBATON	D	AMMON	B	ARENOSA	A	AUGSBURG	B
ABSHER	D	ALBEE	C	AMOLE	C	ARENZVILLE	B	AUGUSTA	C
ACACIO	C	ALBEMARLE	B	AMOR	B	ARGONAUT	D	AULD	D
ACADEMY	C	ALBERTVILLE	C	AMOS	C	ARGUELLO	B	AURA	B
ACADIA	D	ALBIA	C	AMSTERDAM	B	ARGYLE	B	AURORA	C
ACANA	D	ALBION	B	AMTOFT	D	ARIZO	A	AUSTIN	C
ACEITUNAS	B	ALBRIGHTS	C	AMY	D	ARKABUTLA	C	AUXVASSE	D
ACEL	D	ALCALDE	C	ANACAPA	B	ARKPORT	B	AUZQUI	B
ACKER	B	ALCESTER	B	ANAHUAC	D	ARLAND	B	AVA	C
ACKMEN	B	ALCOA	B	ANAMITE	D	ARLING	D	AVALANCHE	B
ACME	C	ALCONA	B	ANAPRA	B	ARLINGTON	A	AVALON	B
ACO	B	ALCOVA	B	ANATONE	D	ARLOVAL	C	AVERY	B
ACOLITA	B	ALDA	C	ANAVERDE	B	ARMAGH	D	AVON	C
ACOVE	C	ALDAX	D	ANCHO	C	ARMINGTON	D	AVONBURG	D
ACTON	B	ALDEN	D	ANCHORAGE	A	ARMO	B	AVONDALE	B
ACUFF	B	ALDER	B	ANCHOR BAY	D	ARMOUR	B	AWBREY	D
ACWORTH	B	ALDERDALE	C	ANCHOR POINT	B	ARMSTER	C	AXTELL	D
ADA	B	ALDERWOOD	C	ANCLOTE	D	ARMSTRONG	D	AYAR	C
ADAIR	D	ALDINO	C	ANCO	C	ARMUCHEE	C	AYCOCK	B
ADAMS	A	ALEKNAGIK	B	ANDERS	C	ARNEGARD	B	AYR	B
ADAMSON	B	ALEX	B	ANDERSON	B	ARNHART	C	AYRES	D
ADAMSTOWN		ALEXANDRIA	C	ANDES	C	ARNHEIM	C	AYRSHIRE	C
ADAMSVILLE	C	ALEXIS	B	ANDORINIA	C	ARNO	D	AYSEES	B
ADATON	D	ALFORD	B	ANDOVER	D	ARNOLD	B	AZTALAN	B
ADAVEN	D	ALGANSEE	B	ANDRES	B	ARNOT	C/D	AZTEC	B
ADDISON	D	ALGIERS	C/D	ANDREWS	C	AROOSTOOK		AZULE	C
ADDY	C	ALGOMA	B/D	ANED	D	AROSA	D	AZWELL	B
ADE	A	ALICE	A	ANETH	A	ARP	D		
ADEL	A	ALICEL	B	ANGELICA	D	ARRINGTON	B	BABB	A
ADELAIDE	D	ALICIA	C	ANGELINA	B/D	ARROLIME	C	BABBINGTON	B
ADELANTO	B	ALIDA	B	ANGIE	C	ARRON	C	BABCOCK	B
ADELPHIA	C	ALIKCHI	D	ANGLE	A	ARROW	B	BABYLON	A
ADENA	C	ALKO	D	ANGLEN	B	ARROWSMITH	B	BACA	C
ADILLIS	A	ALLAGASH	B	ANGOLA	C	ARTA	C	BACH	D
ADIRONDACK		ALLARD	B	ANGOSTURA	B	ARTOIS	C	BACHUS	B
ADKINS	B	ALLEGHENY	B	ANIAK	D	ARVACA	D	BACKBONE	A
ADLER	C	ALLEMANDS	D	ANITA	D	ARVANA	C	BADENAUGH	B
ADOLPH	D	ALLEN	B	ANKENY	A	ARVESON	C	BADGER	C
ADRIAN	A/D	ALLENDALE	C	ANLAUF	C	ARVILLA	B	BADGERTON	B
AENEAS	B	ALLENSVILLE	C	ANNABELLA	A	ARZELL	C	BADO	D
AETNA	B	ALLENTINE	D	ANNANDALE	C	ASA	B	BADUS	C
AFTON	D	ALLENWOOD	B	ANNISTON	B	ASBURY		BAGDAD	B
AGAR	B	ALLEY	C	ANOKA	A	ASCALON	B	BAGGOTT	D
AGASSIZ	D	ALLIANCE	B	ANONES	C	ASCHOFF	B	BAGLEY	B
AGATE	D	ALLIGATOR	D	ANSELMO	A	ASCROFT	B	BAHEM	B
AGAWAM	B	ALLIS	D	ANSON	B	ASHBY	C	BAILE	D
AGENCY	C	ALLISON	C	ANTELOPE SPRINGS	C	ASHDALE	B	BAINVILLE	C
AGER	D	ALLOUEZ	C	ANTERO	C	ASHE	B	BAIRD HOLLOW	C
AGNER	B	ALLOWAY		ANT FLAT	C	ASHKUM	C	BAJURA	D
AGNEW	B/C	ALMAC	B	ANTHONY	B	ASHLEY	A	BAKEOVEN	D
AGNOS	B	ALMENA	C	ANTIGO	B	ASH SPRINGS	C	BAKER	C
AGUA	B	ALMONT	D	ANTILON	B	ASHTON	B	BAKER PASS	B
AGUADILLA	A	ALMY	B	ANTIOCH	D	ASHUE	B	BALAAM	A
AGUA DULCE	C	ALOHA	C	ANTLER	C	ASHUELOT	C	BALCH	D
AGUA FRIA	C	ALONSO	B	ANTOINE	C	ASHWOOD	C	BALCOM	B
AGUEDA	B	ALOVAR	C	ANTY	B	ASKEW	C	BALD	C
AGUILITA	B	ALPENA	B	ANWAY	B	ASO	D	BALDER	C
AGUIRRE	D	ALPON	B	ANZA	B	ASOTIN	C	BALDOCK	B/C
AGUSTIN	B	ALPOWA	B	APACHE	D	ASPEN	B	BALDWIN	D
AHATONE	D	ALPS		APAKUIE	A	ASPERMONT	B	BALDY	B
AHL	C	ALSEA	B	APISHAPA	C	ASSINNIBOINE	B	BALE	C
AHLSTROM	C	ALSTAD	B	APISON	B	ASSUMPTION	B	BALLARD	B
AHMEEK	B	ALSTOWN	B	APPIAN	D	ASTATULA	A	BALLINGER	C
AHOLT	D	ALTAMONT	D	APPLEGATE	C	ASTOR	A/D	BALM	B/C
AHTANUM	C	ALTAVISTA	C	APPLETON	C	ASTORIA	B	BALMAN	B/C
AHWAHNEE	C	ALTDORF	D	APPLING	B	ATASCADERO	C	BALON	B
AIBONITO	C	ALTMAR	B	APRON	B	ATCO	B	BALTIC	D
AIKEN	B	ALTO	C	APT	C	ATEPIC	D	BALTIMORE	B
AIKMAN	D	ALTOGA	C	APTAKISIC	B	ATHELWOLD	B	BAMBER	B
AILEY	B	ALTON	B	ARABY		ATHENA	B	BAMFORTH	B
AINAKEA	B	ALTUS	B	ARADA	B	ATHENS	B	BANCAS	B
AIRMONT	C	ALTVAN	B	ARAPIEN	C	ATHERTON	B/D	BANCROFT	B
AIROTSA	B	ALVIN	B	ARAVE	D	ATHOL	B	BANDERA	B
AIRPORT	D	ALVIRA	C	ARAVETON	B	ATKINSON	B	BANGO	C
AITS	B	ALVISO	D	ARBELA	C	ATLAS	D	BANGOR	B

NOTES A BLANK HYDROLOGIC SOIL GROUP INDICATES THE SOIL GROUP HAS NOT BEEN DETERMINED
TWO SOIL GROUPS SUCH AS B/C INDICATES THE DRAINED/UNDRAINED SITUATION

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Table B.1--Continued

BANGSTON	A	BEATTY		BERTELSON	A	BLAKENEY	C	BORDA	D
BANKARD	A	BEAUCOUP	B	BERTHOUD	B	BLAKEPORT	B	BORDEAUX	B
BANKS	A	BEAUFORD	D	BERTIE	C	BLAMER	C	BORDEN	B
BANNER	C	BEAUMONT	D	BERTOLOTTI	B	BLANCA	B	BORDER	B
BANNERVILLE	C/D	BEAUREGARD	C	BERTRAND	B	BLANCHARD	A	BORNSTEDT	B
BANNOCK	B	BEAUSITE	B	BERVILLE	D	BLANCHESTER	B/D	BORREGO	C
BANQUETE	D	BEAVERTON	B	BERYL	B	BLAND	C	BORUP	B
BARABOO	B	BECK	C	BESSEMER	B	BLANDFORD	C	BORVANT	D
BARAGA	C	BECKER	B	BETHANY	C	BLANDING	B	BORZA	C
BARBARY	D	BECKET	C	BETHEL	D	BLANEY	B	BOSANKO	D
BARBOUR	B	BECKLEY	B	BETTERAVIA	C	BLANKET	C	BOSCO	B
BARBOURVILLE	B	BECKTON	D	BETTS	B	BLANTON	A	BOSKET	B
BARCLAY	C	BECKWITH	C	BEULAH	B	BLANYON	C	BOSLER	B
BARCO	B	BECKWOURTH	B	BEVENT	B	BLASINGAME	C	BOSQUE	B
BARCUS	B	BECREEK	B	BEVERLY	B	BLENCOE	C	BOSS	D
BARD	D	BEDFORD	C	BEW	D	BLENC	D	BOSTON	C
BARDEN	C	BEDINGTON	B	BEWLEYVILLE	B	BLENDON	B	BOSTWICK	B
BARDLEY	C	BEDNER	C	BEWLIN	D	BLETHEN	B	BOSWELL	D
BARELA	C	BEEBE	A	BEXAR	C	BLEVINS	B	BOSWORTH	D
BARFIELD	D	BEECHER	C	BEZZANT	B	BLICHTON	D	BOTELLA	B
BARFUSS	B	BEECHY		BIBB	B/D	BLISS	D	BOTHWELL	C
BARKER	C	BEEHIVE	B	BIBON	A	BLOCKTON	C	BOTTINEAU	C
BARKERVILLE	C	BEEZAR	B	BICKELTON	B	BLODGETT	A	BOTTLE	A
BARKLEY	B	BEHANIN	B	BICKMORE	C	BLOMFORD	B	BOULDER	B
BARLANE	D	BEHEMOTOSH	B	BICONDOA	C	BLOOM	C	BOULDER LAKE	D
BARLOW	B	BEJUCOS	B	BIDDEFORD	D	BLOOMFIELD	A	BOULDER POINT	B
BARNARD	D	BELDEN	D	BIDDLEMAN	C	BLOOMING	B	BOULFLAT	D
BARNES	B	BELDING	B	BIDWELL	B	BLOOR	D	BOURNE	C
BARNESTON	B	BELFAST	B	BIEBER	D	BLOSSOM	C	BOW	C
BARNEY	A	BELFIELD	B	BIENVILLE	A	BLOUNT	C	BOWBELLS	B
BARNHARDT	B	BELFORE	B	BIG BLUE	D	BLUCHER	C	BOWDOIN	D
BARNSTEAD		BELGRADE	B	BIGEL	A	BLUEBELL	C	BOWDRE	C
BARNUM	B	BELINDA	D	BIGETTY	C	BLUE EARTH	D	BOWERS	C
BARRADA	D	BELKNAP	C	BIGGS	A	BLUEJOINT	B	BOWIE	B
BARRINGTON	B	BELLAMY	B	BIGGSVILLE	B	BLUE LAKE	A	BOWMAN	B
BARRON	B	BELLAVISTA	D	BIG HORN	C	BLUEPOINT	B	BOWMANSVILLE	C
BARRONETT	C	BELLE	B	BIG TIMBER	D	BLUE STAR	B	BOX ELDER	C
BARROWS	D	BELLEFONTAINE		BIGWIN	A	BLUEWING	B	BOXWELL	C
BARRY	D	BELLICUM	B	BIJOU	A	BLUFFDALE	C	BOY	A
BARSTOW	B	BELLINGHAM	C	BILLETT	A	BLUFFTON	D	BOYCE	B/D
BARTH	C	BELLPINE	C	BILLINGS	C	BLUFORD	D	BOYD	D
BARTLE	D	BELMONT	B	BINEORD	B	BLY	B	BOYER	B
BARTON	B	BELMORE	B	BINGHAM	B	BLYTHE	D	BOYNTON	
BARTONFLAT	B	BELT	D	BINNSVILLE	D	BOARDTREE	C	BOYSAG	D
BARVON	C	BELTED	D	BINS	B	BOBS	D	BOYSEN	B
BASCOM	B	BELTRAMI	B	BIPPUS	B	BOBTAIL	B	BOZARTH	C
BASEHOR	D	BELTSVILLE	C	BIRCH	A	BOCK	B	BOZE	B
BASHAW	D	BELUGA	C	BIRCHWOOD	C	BODENBURG	B	BOZEMAN	A
BASHER	B	BELVOIR	C	BIRDS	C	BODINE	B	BRACEVILLE	C
BASILE	D	BENCLARE	C	BIRDSALL	D	BOEL	A	BRACKEN	D
BASIN	C	BENEVOLA	C	BIRDSBORO	B	BOELUS	A	BRACKETT	C
BASINGER	C	BENEWAH	C	BIRDSLEY	D	BOETTCHER	C	BRAD	D
BASKET	C	BENFIELD	C	BIRKBECK	B	BOGAN	C	BRADDOCK	C
BASS	A	BENGE	B	BISBEE	A	BOGART	B	BRADENTON	B/D
BASSEL	B	BEN HUR	B	BISCAY	C	BOGUE	D	BRADER	C
BASSETT	B	BENIN	D	BISHOP	B/C	BOHANNON	C	BRADFORD	B
BASSLER	D	BENITO	D	BISPING	B	BOHEMIAN	B	BRADSHAW	A
BASTIAN	D	BENJAMIN	D	BISSELL	B	BOISTFORT	C	BRADWAY	C
BASTROP	B	BEN LOMOND	B	BIT	D	BOLAR	C	BRADY	B
BATAVIA	B	BENMAN	A	BITTERON	A	BOLD	B	BRADYVILLE	C
BATES	B	BENNDALE	B	BITTERROOT	C	BOLES	C	BRAHAM	B
BATH	C	BENNETT	C	BITTER SPRING	C	BOLIVAR	B	BRAINERD	B
BATTLE CREEK	C	BENNINGTON	D	BITTERSPRING	C	BOLIVIA	B	BRALLIER	D
BATZA	C	BENOIT	C	BIXBY	B	BOLTON	B	BRAM	B
BAUDETTE	B	BENSON	C/D	BJORK	C	BOMBAY	B	BRAMARD	B
BAUER	C	BENTONVILLE		BLACHLY	C	BON	B	BRAMBLE	C
BAUGH	B/C	BENZ	D	BLACK BUTTE	C	BONACCORD	D	BRAMWELL	D
BAXTER	B	BECTIA	B	BLACK CANYON	D	BONAPARTE	A	BRAND	D
BAXTERVILLE	B	BEOWAWE	D	BLACKCAP	A	BOND	C	BRANDENBURG	A
BAYAMON	B	BERCAIL	C	BLACKETT	B	BONDRANCH	D	BRANDON	B
BAYARD	A	BERDA	B	BLACKFOOT	B	BONDURANT	B	BRANDYWINE	C
BAYBORO	D	BEREA	C	BLACKHALL	D	BONE	D	BRANFORD	B
BAYSHORE	B/C	BERENICETON	B	BLACKHAWK	D	BONG	B	BRANTFORD	B
BAYSIDE	C	BERENT	A	BLACKLEAF	B	BONHAM	C	BRASHEAR	C
BAYWOOD	A	BERGLAND	D	BLACKLOCK	D	BONILLA	B	BRASSFIELD	B
BAZETTE	C	BERGSTROM	B	BLACKMAN	C	BONITA	D	BRATTON	B
BEAD	C	BERINO	B	BLACK MOUNTAIN	B	BONN	D	BRAXTON	C
BEADLE	C	BERKELEY		BLACKOAK	C	BONNER	B	BRAYMILL	B/D
BEALES	A	BERKS	C	BLACKPIPE	C	BONNET	B	BRAYS	D
BEAR BASIN	B	BERKSHIRE	B	BLACK RIDGE	C	BONNEVILLE	B	BRAYTON	C
BEAR CREEK	C	BERLIN	C	BLACKROCK	B	BONNICK	A	BRAZITO	A
BEARDALL	C	BERMUDIAN	B	BLACKSTON	B	BONNIE	D	BRAZOS	A
BEARDEN	C	BERNAL	C	BLACKTAIL	B	BONO	D	BRECKENRIDGE	D
BEARDSTOWN	C	BERNALDO	B	BLACKWATER	D	BONSALL	D	BRECKNOCK	B
BEAR LAKE	D	BERNARD	D	BLACKWELL	B/D	BONTA	C	BREECE	B
BEARMOUTH	A	BERNARDINO	C	BLADEN	D	BONTI	C	BREGAR	D
BEARPAW	B	BERNARDSTON	C	BLAGG	D	BOOKER	D	BREMEN	B
BEAR PRAIRIE	B	BERNHILL	B	BLAINE	B	BOOMER	B	BREMER	B
BEARSKIN	D	BERNICE	A	BLAIR	C	BOONE	A	BREMO	C
BEASLEY	C	BERNING	C	BLAIRTON	C	BOONESBORO	B	BREMS	A
BEASON	C	BERRENDOS	D	BLAKE	C	BOOTH	C	BRENDA	C
BEATON	C	BERRYLAND	D	BLAKELAND	A	BORAH	A	BRENNAN	B

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Table B.1--Continued

BRENNER	C/D	BUCKLEY	B/C	CAID	B	CAPUTA	C	CATLIN	B
BRENT	C	BUCKLON	D	CAIRO	D	CARACO	C	CATNIP	D
BRENTON	B	BUCKNER	A	CAJALCO	C	CARALAMPI	B	CATOCTIN	C
BRENTWOOD	B	BUCKNEY	A	CAJON	A	CARBO	C	CATLOSA	B
BRESSER	B	BUCKS	B	CALABAR	D	CARBOL	D	CATSKILL	A
BREVARD	B	BUCKSKIN	C	CALABASAS	C	CARBONDALE	D	CATTARAUGUS	C
BREVORT	B	BUCODA	C	CALAIS	C	CARBURY	B	CAUDLE	B
BREWER	C	BUDD	B	CALAMINE	D	CARDIFF	B	CAVE	D
BREWSTER	D	BUDE	C	CALAPOOYA	C	CARDINGTON	C	CAVE ROCK	A
BREWTON	C	BUDE	C	CALAWAH	B	CARDON	D	CAVO	D
BRICKEL	C	BUELL	A	CALCO	C	CAREY	B	CAVODE	C
BRICKTON	C	BUENA VISTA	B	CALDER	D	CAREY LAKE	B	CAVOUR	D
BRIDGE	C	BUFFINGTON	B	CALDWELL	B	CAREYTOWN	D	CAWKER	B
BRIDGEHAMPTON	B	BUFF PEAK	C	CALEAST	C	CARGILL	C	CAYAGUA	C
BRIDGEPORT	B	BUICK	C	CALEB	B	CARIBE	B	CAYLOR	B
BRIDGER	A	BUKREEK	B	CALERA	C	CARIBEL	B	CAYUGA	C
BRIDGESON	B/C	BULLION	D	CALHI	A	CARIBOU	B	CAZADERO	C
BRIDGEVILLE	B	BULLREY	B	CALHOUN	D	CARLIN	D	CAZADOR	B
BRIDGPORT	B	BULL RUN	B	CALICO	D	CARLINTON	B	CAZENOVIA	B
BRIEDWELL	B	BULL TRAIL	B	CALIFON	C	CARLISLE	A/D	CEBOLIA	C
BRIEF	B	BULLY	B	CALIMUS	B	CARLOTTA	B	CECIL	B
BRIENSBURG		BUMGARD	B	CALITA	B	CARLOW	D	CEDARAN	D
BRIGGS	A	BUNCOMBE	A	CALIZA	A	CARLSBAD	C	CEDAR BUTTE	C
BRIGGSDALE	C	BUNDO	B	CALKINS	C	CARLSBORG	A	CEDAREDGE	B
BRIGGSVILLE	C	BUNEJUG	C	CALLAHAN	C	CARLSON	C	CEDAR MT.	D
BRIGHTON	A/D	BUNKER	D	CALLEGUAS	D	CARLTON	B	CEDARVILLE	B
BRIGHTWOOD	C	BUNSELMEIER	C	CALLINGS	C	CARMI	B	CEDONIA	B
BRILL	B	BUNTINGVILLE	B/C	CALLOWAY	C	CARNEGIE	C	CEDRON	C/D
BRIM	C	BUNYAN	B	CALPAR	B	CARNERO	C	CELAYA	B
BRIMFIELD	C/D	BURBANK	A	CALNEVA	C	CARNEY	D	CELETON	D
BRIMLEY	B	BURCH	B	CALCUSE	B	CAROLINE	C	CELINA	C
BRINEGAR	B	BURCHARD	B	CALPINE	B	CARR	B	CELIO	A
BRINKERTON	D	BURCHELL	B/C	CALVERT	D	CARRISALITOS	D	CELLAR	D
BRISCOT	B	BURDETT	C	CALVERTON	C	CARRIZO	A	CENCOVE	B
BRITE	C	BUREN	C	CALVIN	C	CARSO	D	CENTER	C
BRITTON	C	BURGESS	B	CALVISTA	D	CARSON	D	CENTER CREEK	B
BRIZAM	A	BURGI	B	CAM	B	CARSTAIRS	B	CENTERFIELD	B
BROAD	C	BURGIN	D	CAMAGUEY	D	CARSTUMP	C	CENTERVILLE	D
BROADALBIN	C	BURKE	C	CAMARGO	B	CARTAGENA	D	CENTRALIA	B
BROADAX	B	BURKHARDT	B	CAMARILLO	B/C	CARTECAY	C	CENTRAL POINT	B
BROADBROOK	C	BURLEIGH	D	CAMAS	A	CARUSO	C	CERESCO	A
BROAD CANYON	B	BURLESON	D	CAMASCREEK	B/D	CARUTHERSVILLE	B	CERRILLOS	C
BROADHEAD	C	BURLINGTON	A	CAMBERN	C	CARVER	A	CERRO	C
BROADHURST	D	BURMA		CAMBRIDGE	C	CARWILE	C	CHACRA	C
BROCK	D	BURMESTER	D	CAMDEN	B	CARYVILLE	B	CHAFFEE	C
BROCKLISS	C	BURNAC	C	CAMERON	D	CASA GRANDE	C	CHAGRIN	B
BROCKMAN	C	BURNETTE	B	CAMILLUS	B	CASCADE	C	CHAIX	B
BROCKPORT	D	BURNHAM	D	CAMP	B	CASCAJO	B	CHALFONT	C
BROCKTON	D	BURNSIDE	B	CAMPBELL	B/C	CASCILLA	B	CHALMERS	C
BROCKWAY	B	BURNSVILLE	B	CAMPHORA	B	CASCO	B	CHAMA	B
BRODY	C	BURNT LAKE	B	CAMPIA	B	CASE	B	CHAMBER	C
BROGAN	B	BURRIS	D	CAMPO	C	CASEBIER	D	CHAMBERINO	C
BROGDON	B	BURT	D	CAMPONE	B/C	CASEY	C	CHAMISE	B
BROLLIAR	D	BURTON	B	CAMPSPASS	C	CASHEL	C	CHAMOKANE	B
BROMO	B	BUSE	B	CAMPUS	B	CASHION	D	CHAMPION	B
BRONAUGH	B	BUSHNELL	C	CAMRODEN	C	CASHMERE	B	CHANCE	B/D
BRONCHO	B	BUSHVALLEY	D	CANA	C	CASHMONT	B	CHANDLER	B
BRONSON	B	BUSTER	C	CANAAN	C/D	CASINO	A	CHANEY	C
BRONTE	C	BUTANO	C	CANADIAN	B	CASITO	C	CHANNAHON	B
BROOKE	C	BUTLER	D	CANADICE	D	CASPAR	B	CHANNING	B
BROOKFIELD	B	BUTLERTOWN	C	CANANDAIGUA	D	CASPIANA	B	CHANTA	B
BROOKINGS	B	BUTTE	C	CANASERAGA	C	CASS	A	CHANTIER	D
BROOKLYN	D	BUTTERFIELD	C	CANAVERAL	C	CASSADAGA		CHAPIN	C
BROOKSIDE	C	BUXIN	D	CANDELERO	C	CASSIA	C	CHAPMAN	
BROOKSTON	B/D	BUXTON	C	CANE	C	CASSCLARY	B	CHAPPELL	B
BROOKSVILLE	D	BYARS	D	CANEADEA	D	CASSVILLE		CHARD	B
BROSELEY	B	BYRON	A	CANEEK	B	CASTAIC	C	CHARITON	D
BROSS	B			CANEL	B	CASTALIA	C	CHARITY	D
BROUGHTON	D	CABALLO	C	CANELOX	C	CASTANA	B	CHARLESTON	C
BROWARD	C	CABARTON	C	CANEY	C	CASTELL	C	CHARLEVOIX	B
BROWNELL	B	CABBA	C	CANEYVILLE	C	CASTILE	B	CHARLOS	A
BROWNFIELD	A	CABBART	D	CANFIELD	C	CASTINO	C	CHARLOTTE	A/D
BROWNLEE	B	CABEZON	D	CANISTEO	C	CASTLE	D	CHARLTON	B
BROYLES	C	CABIN	C	CANNINGER	B	CASTLE VALLEY	D	CHASE	C
BRUCE	D	CABINET	C	CANOE	B	CASTNER	C	CHASEBURG	B
BRUIN	C	CABLE	D	CANONCITO	C	CASTO	C	CHASEVILLE	A
BRUNEEL	B	CABO ROJO	C	CANOVA	B/D	CASTRO	C	CHASKA	C
BRUNO	A	CABOT	C	CANTON	B	CASTROVILLE	B	CHASTAIN	D
BRUNT	C	CACAPON	B	CANTRIL	B	CASUSE	C	CHATBURN	B
BRUSETT	B	CACHE	D	CANTUA	B	CASWELL	B	CHATFIELD	
BRUSH		CACIQUE	B	CANUTIO	B	CATALINA	B	CHATHAM	B
BRUSSETT	B	CADDO	D	CANYON	D	CATALPA	C	CHATSWORTH	D
BRYAN	A	CADEVILLE	D	CAPAC	B	CATANO	A	CHAUNCEY	C
BRYCAN	B	CADMUS	B	CAPAY	D	CATARINA	D	CHAVIES	B
BRYCE	D	CADOGMA	C	CAPE	D	CATAULA	C	CHAWANAKEE	C
BUCAN	D	CADOR	C	CAPE FEAR	D	CATAWBA	B	CHEADLE	C
BUCHANAN	C	CAGEY	C	CAPERS	D	CATH	D	CHECKETT	D
BUCHENAU	C	CAGUABO	D	CAPILLO	D	CATHCART	B	CHEDAHAP	B
BUCHER	C	CAHABA	B	CAPLES	C	CATHEDRAL	C	CHEEKTOWAGA	D
BUCKINGHAM		CAHILL	B	CAPPS	B	CATHERINE	B/D	CHEESMAN	B
BUCKLAND	C	CAHONE	C	CAPSHAW	C	CATHRO	D	CHEHALEM	C
BUCKLEBAR	B	CAHTO	C	CAPULIN	C	CATLETT	C/D	CHEMALIS	B

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Table B.1--Continued

CHEHULPUM	C	CHUTE	A	COACHELLA	B	CONALB	B	COTITO	C
CHOLAN	B	CIALES	D	COAD	B	CONANT	C	COTO	C
CHELSEA	A	CIALITOS	B	COAL CREEK	C	CONASAUGA	C	COTOPAXI	A
CHEMAWA	B	CIBEQUE	B	COALMONT	C	CONATA	D	COTT	B
CHEMUNG		CIBO	D	COAMO	C	CONBOY	D	COTTER	B
CHEN	D	CIBOLA	B	COARSEGOLD	B	CONCHAS	C	COTTERAL	B
CHENA	A	CICERO	D	COATICOOK	C	CONCHO	C	COTTIER	B
CHENANGO	A	CIDERCONE	B	COATSBURG	D	CONCONULLY	B	COTTONWOOD	C
CHENEY	B	CIDRAL	C	COBB	B	CONCORD	D	COTTRELL	C
CHENNEBY	C	CIENEBA	B	COBEN	D	CONCREEK	B	COUCH	C
CHENOWETH	B	CIMA	C	COBEY	B	CONDA	C	COUGAR	C
CHEQUEST	C	CIMARRON	C	COBURG	C	CONDIT	C	COULSTONE	B
CHEREFTE	A	CINCINNATI	C	COCHETOPA	C	CONDON	C	COUNTS	C
CHEROKEE	D	CINCO	A	COCOA	A	CONE	A	COUPEVILLE	B
CHERRY	C	CINEBAR	B	COCOLALLA	C	CONEJO	C	COURT	B
CHERRYHILL	C	CIRCLE	C	CODORUS	C	CONESTOGA	B	COURTHOUSE	D
CHERRY SPRINGS	D	CIRCLEVILLE	C	CODY	A	CONESUS	B	COURTLAND	B
CHESAW	B	CISNE	D	COE	A	CONGAREE	B	COURTNEY	D
CHESHIRE	B	CISPUS	A	COEBURN	C	CONI	D	COURTROCK	B
CHESHNINA	D	CITICO	B	COFF	D	CONLEN	B	COUSE	C
CHESNIMNUS	B	CLACKAMAS	C	COGGON	B	CONLEY	C	COUSHATTA	B
CHESTER	B	CLAIBORNE	B	COGSWELL	C	CONNEAUT	C	COVE	D
CHESTERTON	C	CLAIRE	A	COHASSET	B	CONNECTICUT		COVEILG	B
CHETCO	D	CLAIREMONT	B	COHOCTAH	D	CONNER	B	COVELAND	C
CHETEK	B	CLALLAM	B	COHOE	B	CONOTTON	B	COVENTRY	B
CHEVELON	C	CLAM GULCH	C	COIT	C	CONOVER	B	COVEYTOWN	C
CHEWACLA	C	CLAMO	C	COKEDALE	C	CONOWINGO	C	COVINGTON	D
CHEWELAH	B	CLANTON	C	COKEL	C	CONRAD	B	COWAN	A
CHEYENNE	B	CLAPPER	B	COKER	D	CONROE	B	COWARTS	C
CHIARA	D	CLAREMORE	C	COKESBURY	D	CONSER	C/D	COWDEN	D
CHICKASHA	B	CLARENCE	D	COKEVILLE	B	CONSTABLE	A	COWERY	C
CHICOPEE	B	CLARESON	C	COLBATH	C/D	CONSUMO	B	COWEEMAN	C
CHICOTE	D	CLAREVILLE	C	COLBERT	D	CONTINENTAL	C	COWERS	B
CHIGLEY	C	CLARINDA	D	COLBURN	B	CONTRA COSTA	C	COWICHE	B
CHILCOTT	D	CLARION	B	COLBY	B	CONVENT	C	COWOOD	C
CHILDS	B	CLARITA	D	COLCHESTER	B	COOK	D	COX	D
CHILGREN	C	CLARK	B	COLDEN		COOKPORT	C	COXVILLE	D
CHILHOWIE	C	CLARK FORK	A	COLD SPRINGS	C	COOLBRITH	B	COYATA	C
CHILI	B	CLARKSBURG	C	COLE	B/C	COOLVILLE	C	COZAD	B
CHILLICOTHE	C	CLARKSDALE	C	COLEBROOK	B	COOMBS	B	CRABTON	B
CHILLISQUAQUE		CLARKSON	B	COLEMAN	C	COONEY	B	CRADDOCK	B
CHILLUM	B	CLARKSVILLE	B	COLEMANTOWN	D	COOPER	C	CRADLEBAUGH	D
CHILMARK	B	CLARNO	B	COLETO	A	COOTER	C	CRAFTON	C
CHILO	B/D	CLARY	B	COLFAX	C	COPAKE	B	CRAGO	B
CHILOQUIN	B	CLATO	B	COLINAS	B	COPALIS	B	CRAIG	C
CHILSON	D	CLATSOP	D	COLLAMER	C	COPELAND	B/D	CRAIGMONT	C
CHILTON	B	CLAVERACK	C	COLLARD	B	COPITA	B	CRAPER	D
CHIMAYO	C	CLAWSON	C	COLLBRAN	C	COPLAY		CRANE	B
CHIMNEY	B	CLAYBURN	B	COLLEEN	C	COPPER RIVER	D	CRANSTON	B
CHINA CREEK	B	CLAYSPRINGS	D	COLLEGIATE	C	COPPERTON	B	CRARY	C
CHINCHALLO	B/D	CLAYTON	B	COLLETT	C	COPPOCK	B	CRATER LAKE	B
CHINIAK	A	CLEARFIELD	C	COLLIER	A	COPSEY	D	CRAVEN	C
CHINO	B/C	CLEAR LAKE	D	COLLINGTON	B	COQUILLE	C/D	CRAWFORD	D
CHINOOK	B	CLEEK	C	COLLINS	C	CORA	D	CREAL	D
CHIPETA	D	CLE ELUM	B	COLLINSTON	C	CORAL	C	CREBBIN	C
CHIPLEY	C	CLEGG	B	COLLINSVILLE	C	CORBETT	C	CREEDMAN	D
CHIPMAN	C	CLEMAN	B	COLMA	B	CORBIN	B	CREEDMOOR	C
CHIPPENY	D	CLEMVILLE	B	COLMOR	C	CORCEGA	C	CREIGHTON	B
CHIPPEWA	B/D	CLEORA	B	COLO	B	CORD	C	CRELDON	B
CHIQUITO	C	CLERF	B	COLOCKUM	B	CORDES	B	CRESBARD	C
CHIRICAHUA	D	CLERMONT	C	COLOMA	A	CORDOVA	C	CRESCENT	B
CHITINA	B	CLEVERLY	A	COLOMBO	B	CORINTH	C	CRESCO	C
CHITTENDEN	C	CLIFFDOWN	C	COLONA	C	CORKINDALE	B	CREST	C
CHITWOOD	C	CLIFFHOUSE	C	COLONIE	A	CORLENA	A	CRESTLINE	B
CHIVATO	D	CLIFFORD	B	COLORADO	B	CORLETT	B	CRESTMORE	
CHIWAWA	B	CLIFFWOOD	C	COLOROCK	D	CORLEY	C	CRESTON	A
CHO	C	CLIFTERSON	B	COLOSO	D	CORMANT	C	CRESWELL	C
CHOBEE	D	CLIFTON	C	COLOSSE	A	CORNHILL	B	CRETE	D
CHOCK	B/D	CLIFTY	B	COLP	D	CORNING	D	CREVA	D
CHOCOLOCCO	B	CLIMARA	D	COLRAIN	B	CORNUTT	C	CREVASSE	A
CHOPAKA	C	CLIMAX	C	COLTON	A	CORNVILLE	B	CREWS	D
CHOPTANK	A	CLIME	C	COLTS NECK	B	COROZAL	C	CRIDER	B
CHOPTIE	D	CLINTON	B	COLUMBIA	B	CORPENING	D	CRIM	B
CHORALMONT	B	CLODINE	D	COLUMBINE	A	CORRALITOS	A	CRISFIELD	B
CHOTEAU	C	CLONTARF	B	COLUSA	C	CORRECO	C	CRITCHELL	B
CHRISTIAN	C	CLOQUALLUM	C	COLVILLE	B	CORRERA	D	CRIVITZ	A
CHRISTIANA	B	CLOQUATO	B	COLVIN	C	CORSON	C	CROCKER	A
CHRISTIANBURG	D	CLOQUET	B	COLWOOD	B/D	CORTEZ	D	CROCKETT	D
CHRISTY	B	CLOUD	D	COLYER	C/D	CORTINA	A	CROFTON	B
CHROME	C	CLOUDCROFT	C	COMERIC	B	CORUNNA	C	CROGHAN	B
CHUALAR	B	CLOUD PEAK	B	COMETA	C	CORVALLIS	B	CROOKED	C
CHUBBS	C	CLOUD RIM	B	COMFREY	C	CORWIN	B	CROOKED CREEK	D
CHUCKAWALLA	B	CLOUGH	D	COMITAS	A	CORY	C	CROOKSTON	B
CHULITNA	B	CLOVERDALE	C	COMLY	C	CORYDON	C	CROOM	B
CHUMMY	C	CLOVER SPRINGS	B	COMMERCE	C	COSAD	C	CROPLEY	C
CHUMSTICK	C	CLOVIS	B	COMO	A	COSH	C	CROSBY	C
CHUPADERA	B	CLUFF	C	COMODORE	B	COSHOCTON		CROSS	D
CHURCH	D	CLUNIE	D	COMORO	B	COSKI	B	CROSSVILLE	B
CHURCHILL	D	CLURO	C	COMPTCHE	B	COSSAYUNA	C	CROSWELL	A
CHURCHVILLE	D	CLURG	C	COMPTON	C	COSTILLA	A	CROT	D
CHURN	B	CLYDE	C	COMSTOCK	C	COTACO	C	CROTON	D
CHURNUASHER	B	CLYMER	B	COMUS	B	COTATI	C	CROUCH	B

NOTES A BLANK HYDROLOGIC SOIL GROUP INDICATES THE SOIL GROUP HAS NOT BEEN DETERMINED
TWO SOIL GROUPS SUCH AS B/C INDICATES THE DRAINED/UNDRAINED SITUATION

Table B.1--Continued

CROW	C	DANZ	B	DEL REY	C	DIXMONT	C	DRY CREEK	C
CROW CREEK	B	DARGOL	D	DEL RIO	C	DIXMORE	B	DRYDEN	B
CROWFOOT	C	DARIEN	C	DELTA	C	DIXONVILLE	C	DRY LAKE	C
CROWHEART	B	DARLING	B	DELTON	B	DIXVILLE	A	DUANE	B
CROW HILL	C	DARNELL	C	DELWIN	A	DOAK	C	DUBAKELLA	C
CROWLEY	D	DARNEN	B	DELYNDIA	B	DOBBS	B	DUBAY	D
CROWN	B	DARR	A	DEMAST	B	DOBY	D	DUBBS	B
CROWSHAW	B	DARRET	C	DEMASTERS	B	DOCAS	B	DUBOIS	C
CROZIER	C	DARROCH	C	DE MAYA	C	DOCKERY	C	DUBUQUE	B
CRUCKTON	B	DART	A	DEMERS	D	DOCT	B	DUCEY	B
CRUICKSHANK	C	DARVADA	D	DEMKY	D	DODGE	B	DUCHESNE	A
CRUME	B	DARWIN	D	DEMONA	C	DODGEVILLE	B	DUCKETT	C
CRUMP	D	DASSEL	D	DEMOPOLIS	C	DODSON	C	DUCOR	C
CRUTCH	B	DATEMAN	C	DEMPSTER	B	DOGER	A	DUDA	A
CRUTCHER	D	DATINO	C	DENAY	B	DOGUE	C	DUDLEY	D
CRUZE	C	DATWYLER	C	DENISON	C	DOLAND	B	DUEL	B
CRYSTAL LAKE	B	DAULTON	D	DENMARK	D	DOLE	C	DUELM	C
CRYSTAL SPRINGS	D	DAUPHIN		DENNIS	C	DOLLAR	B	DUFFAU	B
CRYSTOLA	B	DAVEY	A	DENNY	D	DOLLARD	C	DUFFER	D
CUBA	B	DAVIDSON	B	DENROCK	D	DOLORES	B	DUFFIELD	B
CUBERANT	B	DAVIS	B	DENTON	D	DOLPH	C	DUFFSON	B
CUCHILLAS	D	DAVISON	B	DENVER	C	DOMINGO	C	DUFFY	B
CUDAHY	D	DAWES	C	DEPEW	C	DOMINGUEZ	C	DUFUR	B
CUDIYO	B	DAWHOO	B/D	DEPOE	D	DOMINIC	A	DUGGINS	D
CUERO	B	DAWSON	D	DERINDA	C	DOMINO	C	DUGOUT	D
CUEVA	D	DAY	D	DESAN	A	DONA ANA	B	DUGWAY	C
CUEVITAS	D	DAYBELL	A	DESART	C	DONALD	B	DUKES	A
CULLEN	C	DAYTON	D	DESCALABRADO	D	DONEGAL		DULAC	C
CULLEOKA	B	DAYVILLE	B/C	DESCHUTES	C	DONERAIL	C	DUMAS	B
CULLO	C	DAZE	D	DESERET	C	DONICA	A	DUMECQ	C
CULPEPER	C	DEACON	B	DESHA	D	DONLONTON	C	DUMONT	C
CULVERS	C	DEADFALL	B	DESHLER	C	DONNA	D	DUNBAR	D
CUMBERLAND	B	DEAMA	C	DESOLATION	C	DONNAN	C	DUNBARTON	C
CUMLEY	C	DEAN	B	DESRAIN	B	DONNYBROOK	D	DUNBRIDGE	B
CUMMINGS	B/D	DEAN LAKE	C	DETER	C	DONOVAN	B	DUNCAN	D
CUNICO	C	DEARDURFF	B	DETLOR	C	DOOLEY	A	DUNCANNON	B
CURPER	B	DEARY	C	DETOUR	C	DOONE	B	DUNCOM	D
CURDLI	C	DEARYTON	B	DETROIT	C	DOOR	B	DUNDAS	C
CURECANTI	B	DEATMAN	C	DEV	B	DORA	D	DUNDAY	A
CURLEW	C	DEAVER	C	DEVILS DIVE	D	DORAN	C	DUNDEE	C
CURRAN	C	DEBENGER	C	DEVOL	B	DORCHESTER	B	DUNELLEN	B
CURRANT	B	DECAN	D	DEVON	B	DOROSHIN	C	DUNE SAND	A
CURTIS CREEK	D	DECATHON	D	DEVORE	B	DOROTHEA	C	DUNGENESS	B
CURTIS SIDING	A	DECATUR	B	DEWART		DORDVAN	D	DUN GLEN	C
CUSHING	B	DECCA	B	DEWEY	B	DORS	B	DUNKINSVILLE	B
CUSHMAN	C	DECKER	C	DEWVILLE	B	DORSET	B	DUNKIRK	B
CUSTER	C	DECKERVILLE	C	DEXTER	B	DOS CABEZAS	C	DUNLAP	B
CUTTER	D	DECLO	B	DIA	C	DOSSMAN	B	DUNMORE	B
CUTZ	D	DECORRA	B	DIABLO	D	DOTHAN	B	DUNNING	D
CUYAMA	B	DECROSS	B	DIAMOND	C	DOTTA	B	DUNPHY	C
CYLINDER	B	DEE	C	DIAMOND SPRINGS	C	DOTY	B	DUNVILLE	B
CYNTHIANA	C/D	DEERWATER	C	DIAZ	C	DOUBLETOP	B	DU PAGE	B
CYRREMORT	C	DEER CREEK	C	DIBBLE	C	DOUDS	B	DUREE	C
CYRIL	B	DEERFIELD	B	DICK	A	DOUGHERTY	A	DUPLIN	C
		DEERFORD	D	DICKEY	A	DOUGHTY	A	DUPO	C
DABOB	B	DEERING	C	DICKINSON	A	DOUGLAS	B	DUPONT	D
DACONO	C	DEERLODGE	D	DICKSON	C	DOURO	B	DUPREE	D
DADE	A	DEER PARK	A	DIGBY	C	DOVER	B	DURALDE	C
DAFTER	B	DEERTON	B	DIGGER	C	DOVRAY	D	DURAND	B
DAGGETT	A	DEERTRAIL	C	DIGHTON	B	DOW	B	DURANT	D
DAGLUM	D	DEFIANCE	D	DILL	B	DOWAGIAC	B	DURELLE	B
DAGOR	B	DEFORD	D	DILLARD	C	DOWDEN	C	DURHAM	B
DAGUAO	C	DEGARMO	B/C	DILLDOWN		DOWELLTON	D	DURKEE	C
DAGUEY	C	DEGNER	C	DILLINGER	B	DOWNER	B	DURDO	B
DAHLQUIST	B	DE GREY	D	DILLON	D	DOWNEY	B	DURRSTEIN	D
DAIGLE	C	DEJARNET	B	DILLWYN	A	DOWNS	B	DUTCHESS	B
DAILEY	A	DEKALB	C	DILMAN	C	DOXIE	C	DUTSON	C
DAKOTA	B	DEKOVEN	D	DILTS	D	DOYCE	C	DUTTON	D
DALBO	B	DELAKE	B	DILWORTH	C	DOYLE	A	DUVAL	B
DALBY	D	DELANCO	C	DIMAL	C	DOYLE	A	DUZEL	B
DALE	B	DELANEY	A	DIMYAW	C	DOYLESTOWN	D	DWIGHT	D
DALHART	B	DELANO	B	DINGLE	B	DOYN	C	DWYER	A
DALIAN	B	DELECO	D	DINGLISHNA	C	DRA	C	DYE	D
DALLAM	B	DELENA	D	DINKELMAN	B	DRACUT	C	DYER	
DALTON	C	DELFINA	B	DINKEY	A	DRAGE	B	DYKE	B
DALUPE	B	DELHI	A	DINNEN	B	DRAGOON	B	DYRENG	D
DAMASCUS	D	DELICIAS	B	DINSDALE	B	DRAGSTON	C		
DAMON	D	DELKS	B/D	DINUBA	B/C	DRAIN	D	EAD	C
DANA	B	DELL	C	DINZER	B	DRAKE	B	EAGAR	B
DANBURY	C	DELLEKER	B	DIOXICE	C	DRANYON	B	EAGLECONE	B
DANEY		DELLO	A/C	DIQUE	B	DRAPER	C	EAKIN	B
DANDREA	C	DELLROSE	B	DISAPEL	D	DRESDEN	B	EAMES	B
DANDRIDGE	D	DELM	D	DISAUTEL	B	DRESSLER	C	EARLE	C
DANGBERG	D	DELMAR	D	DISCO	B	DREWS	B	EARLMONT	B/C
DANIELS	B	DELMITA	C	DISHNER	D	DRIFTON	C	EARR	B
DANKO	D	DELMONT	B	DISTERHEFF	C	DRIGGS	B	EASLEY	C
DANLEY	C	DELNORTE	C	DITCHCAMP	C	DRUM	C	EAST FORK	C
DANNEMORA	D	DELPHI	B	DIVERS	B	DRUMMER	B	EAST LAKE	A
DANSKIN	B	DELPHILL	C	DIVIDE	B	DRUMMOND	C	EASTLAND	C
DANT	D	DELPIEDRA	C	DIX	A	DRURY	B	EASTON	C
DANVERS	C	DELRINE	D	DIX	A	DRYAD	C	EASTONVILLE	A
DANVILLE	C	DELRAY	A/D	DIXIE	C	DRYBURG	B	EAST PARK	D

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TWO SOIL GROUPS SUCH AS B/C INDICATES THE DRAINED/UNDRAINED SITX-

Table B.1--Continued

EASTPORT	A	ELLISON	B	ESMOND	B	FARNUM	B	FLEISCHMANN	D
EATONTOWN		ELLOAM	C	ESPARTO	B	FARRAGUT	C	FLEMING	C
EAUGALLIE	B/D	ELLSBERRY		ESPIL	D	FARRAR	B	FLETCHER	B
EBA	C	ELLSWORTH	C	ESPINAL	A	FARRELL	B	FLOKE	D
EBBERT	D	ELMA	B	ESQUATZEL	B	FARRENBURG	B	FLOM	C
EBBS	B	ELMDALE	B	ESS	B	FARROT	C	FLOMATION	A
EBENEZER	C	ELMIRA	A	ESSEN	C	FARSON	B	FLORENCE	C
ECCLES	B	ELMO	C	ESSEX	C	FARWELL	C	FLORIDANA	B/D
ECHARD	C	ELMONT	B	ESSEXVILLE	D	FATIMA	B	FLORISSANT	C
ECHLER	B	ELMORE	B	ESTACADO	B	FATTIG	C	FLOWELL	C
ECKLEY	B	ELMWOOD	C	ESTELLINE	B	FAUNCE	A	FLOWEREE	B
ECKMAN	B	ELNORA	B	ESTER	D	FAUQUIER	C	FLOYD	B
ECKRANT	D	ELOIKA	B	ESTERBROOK	B	FAWCETT	C	FLUSHING	
ECTOR	C	ELPAN	D	ESTHERVILLE	B	FAWN	B	FLUVANNA	C
EDALGO	C	EL PECO	C	ESTU	C	FAXON	D	FLYGARE	B
EDDS	B	EL RANCHO	B	ESTRELLA	B	FAYAL	C	FLYNN	D
EDDY	C	ELRED	B/D	ETHAN	B	FAYETTE	B	FOARD	D
EDEN	C	ELRED	B/D	ETHETE	B	FAYETTEVILLE	B	FOGELSVILLE	B
EDENTON	C	ELS	A	ETHRIDGE	C	FAYWOOD	C	FOLA	B
EDENVALE	D	ELSAH	B	ETIL	A	FE	D	FOLEY	D
EDGAR	B	ELSINBORO	B	ETNA		FEDORA	B	FONDA	D
EDGECUMBE	B	ELSMERE	A	ETOWAH	B	FELDA	B/D	FONDIS	C
EDGELEY	C	ELSO	D	ETOWN	B	FELIDA	B	FONTAL	C
EDGEMONT	B	EL SOLYO	C	ETTA	C	FELLOWSHIP	D	FONTREEN	B
EDGEWATER	C	ELSTON	B	ETTER	B	FELT	B	FOPIANO	D
EDGEWICK	B	ELTOPIA	B	ETTERSBURG	B	FELTA	C	FORBES	B
EDGEWOOD	A	ELTREE	B	ETTRICK	D	FELTHAM	A	FORD	D
EDGINGTON	C	ELTSAC	D	EUBANKS	B	FELTON	B	FORDNEY	A
EDINA	D	ELWHA	B	EUDORA	B	FELTONIA	B	FORDVILLE	B
EDINBURG	C	ELWOOD	C	EUFAULA	A	FENCE	B	FORE	D
EDISON	B	ELY	B	EUREKA	D	FENDALL	C	FORELAND	C
EDISTO	C	ELYSIAN	B	EUSTIS	A	FENWOOD	B	FORELLE	B
EDITH	A	ELZINGA	B	EUTAW	D	FERDELFORD	C	FORESMAN	B
EDLOE	B	EMBDEN	B	EVANGELINE	C	FERDIG	C	FORESTDALE	D
EDMONDS	C	EMDENT	C	EVANS	B	FERGUS	B	FORESTER	C
EDMORE	D	EMER	C	EVANSTON	B	FERGUSON	B	FORGAY	A
EDMUND	C	EMERALD	B	EVARO	A	FERNANDO	C	FORMAN	B
EDNA	D	EMERSON	B	EVART	D	FERNDALE	B	FORNEY	D
EDNEYVILLE	B	EMIDA	D	EVENDALE		FERNLEY	C	FORREST	C
EDOM	C	EMIGRANT	B	EVERETT	B	FERNOW	B	FORSEY	C
EDSON	C	EMIGRATION	D	EVERGLADES	A/D	FERNPOINT	C	FORSGREN	C
EDWARDS	B/D	EMILY	B	EVERLY	B	FERRELO	B	FORT COLLINS	B
EEL	C	EMLIN	B	EVERMAN	C	FERRIS	D	FORT DRUM	C
EFFINGTON	D	EMMA	C	EVERSON	C	FERRON	B	FORT LYON	B
EFWUN	A	EMMERT	A	EVESBORO	A	FERTALINE	D	FORT MEADE	A
EGAM	C	EMMET	B	EWA	B	FESTINA	B	FORT MOTT	A
EGAN	B	EMMONS	C	EWAIL	A	FETTIC	D	FORT PIERCE	C
EGBERT	B/C	EMORY	B	EWINGSVILLE	B	FIANDER	C	FORT ROCK	C
EGELAND	B	EMPEY	B	EXCHEQUER	D	FIBEA	D	FORTUNA	D
EGGLESTON	B	EMPEYVILLE	C	EXETER	C	FIDALGO	C	FORTWINGATE	C
EGNAR	C	EMPIRE	C	EXLINE	D	FIDDLETOWN	C	FORWARD	C
EICKS	C	EMRICK	B	EXRAY	D	FIDDYMENT	C	FOSHOME	B
EIFORT		ENCE	B	EXUM	C	FIELDING	B	FOSSUM	B
EKAH	C	ENCIERRO	D	EYERBOW	D	FIELDON	B	FOSTER	B/C
EKALAKA	B	ENCINA	B	EYRE	B	FIELDSON	A	FOSTORIA	B
ELAM	A	ENDERS	C			FIFE	B	FOUNTAIN	D
ELBERT	D	ENDICOTT	B	FABIUS	B	FIFER	D	FOURLOG	D
ELBURN	B	ENET	B	FACEVILLE	B	FILLMORE	D	FOURMILE	B
ELCO	B	ENFIELD	B	FAHEY	B	FINCASTLE	C	FOUR STAR	B/C
ELD	B	ENGLE	B	FAIM	C	FINGAL	C	FOUTS	B
ELDER	B	ENGLESIDE	B	FAINES	A	FINLEY	B	FOX	B
ELDER HOLLOW	D	ENGLEWOOD	C	FAIRBANKS	B	FIRESTEEL	B	FOXCREEK	C
ELDERON	B	ENGLUND	D	FAIRDALE	B	FIRGRELL	B	FOXMOUNT	C
ELDON	B	ENNIS	B	FAIRFAX	B	FIRMAGE	B	FOXOL	D
ELDORADO	C	ENOCHVILLE	B/D	FAIRFIELD	B	FIRO	C	FOXPARK	B
ELDRIDGE	C	ENOLA	B	FAIRHAVEN	B	FIRTH	B	FOXTON	C
ELEPHANT	D	ENON	C	FAIRMOUNT	D	FISH CREEK	B	FRAILEY	C
ELEROY	B	ENOS	B	FAIRPORT	C	FISHERS	B	FRAM	B
ELFRIDA	B	ENOSBURG	D	FAJARDO	C	FISHHOOK	D	FRANCIS	A
ELIJAH	C	ENSIGN	D	FALAYA	C	FISHKILL		FRANK	D
ELIOAK	C	ENSLEY	D	FALCON	C	FITCH	A	FRANKFORT	D
ELK	B	ENSTROM	B	FALFURRIAS	A	FITCHVILLE	C	FRANKIRK	C
ELKADER	B	ENTERPRISE	B	FALK	B	FITZGERALD	B	FRANKLIN	B
ELKCREEK	C	ENTIAT	D	FALKNER	C	FITZHUGH	B	FRANKSTOWN	B
ELK HOLLOW	B	ENUMCLAW	C	FALL	B	FIVE OUT	B	FRANKTOWN	D
ELKHORN	B	EPHRAIM	C	FALLBROOK	B	FIVEMILE	B	FRANKVILLE	B
ELKINS	D	EPHRATA	B	FALLON	C	FIVES	B	FRATERNIDAD	D
ELKINSVILLE	B	EPOUFETTE	D	FALLSBURG		FLAGG	B	FRAZER	C
ELKMOUND	C	EPPING	D	FALLSINGTON	D	FLAGSTAFF	C	FRED	C
ELK MOUNTAIN	B	EPSIE	D	FANCHER	C	FLAK	B	FREDENSBORG	C
ELKTON	D	ERA	B	FANG	C	FLAMING	B	FREDERICK	B
ELLABELLE	B/D	ERAM	C	FANNIN	B	FLAMINGO	D	FREDON	C
ELLEDGE	D	ERBER	C	FANNO	C	FLANAGAN	B	FREDONIA	C
ELLERY	D	ERIC	B	FANU	C	FLANDREAU	B	FREDRICKSON	C
ELLETT	D	ERIE	C	FARADAY	C	FLASHER	A	FREEBURG	C
ELLIBER	A	ERIN	B	FARALLONE	B	FLATHEAD	A	FREECE	D
ELLICOTT	A	ERNEST	C	FARAWAY	D	FLAT HORN	B	FREEHOLD	B
ELLINGTON	B	ERRAMOUSPE	C	FARGO	D	FLATTOP	D	FREEL	B
ELLINOR	B	ESCAL	B	FARISTA	B	FLAXTON	A	FREEMAN	C
ELLIOTT	C	ESCALANTE	B	FARLAND	B	FLEAK	A	FREEMANVILLE	B
ELLIS	D	ESCAMBIA	C	FARMINGTON	C/D	FLECHADO	C	FREEON	B
ELLISFORDE	C	ESCONDIDO	C	FARNUF	B	FLEETWOOD		FREER	C

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TWO SOIL GROUPS SUCH AS B/C INDICATES THE DRAINED/UNDRAINED SITUATION

Table B .1--Continued

FREESTONE	C	GASCONADE	D	GLENFIELD	D	GRANGER	C	GUNN	B
FREEZENER	B	GAS CREEK	C	GLENFORD	C	GRANGEVILLE	B/C	GUNTER	A
FREMONT	C	GASKELL	C	GLENHALL	B	GRANILE	B	GURABO	D
FRENCH	C	GASS	D	GLENHAM	B	GRANO	D	GURNEY	C
FRENCHTOWN	D	GASSET	D	GLENMORA	C	GRANT	B	GUSTAVUS	B
FRENEAU		GATESBURG	A	GLENNALLEN	C	GRANTSBURG	C	GUSTIN	C
FRESNO	C	GATEVIEW	B	GLENOMA	B	GRANTSDALE	A	GUTHRIE	D
FRIANA	D	GATEWAY	C	GLENROSE	B	GRANVILLE	B	GUYTON	D
FRIANT	D	GATEWOOD	D	GLENSTED	D	GRAPEVINE	C	GWIN	D
FRIDLO	C	GAULDY	B	GLENTON	B	GRASMERE	B	GWINNETT	B
FRIEDMAN	B	GAVINS	C	GLENVIEW	B	GRASSNA	B	GYMER	C
FRIES	D	GAVIOTA	D	GLENVILLE	C	GRASSY BUTTE	A		
FRIO	B	GAY	D	GLIDE	B	GRATZ	C	HACKE	C
FRIZZELL	C	GAYLORD	B	GLIKON	B	GRAVDEN	C	HACIENDA	C
FROBERG	D	GAYNOR	C	GLORIA	C	GRAVE	B	HACK	B
FROHMAN	C	GAYVILLE	B	GLOUCESTER	A	GRAVITY	C	HACKERS	B
FRONHOFER	C	GAZELLE	D	GLOVER	C/D	GRAYCALM	A	HACKETTSTOWN	B
FRONTON	D	GAZOS	B	GLYNDON	B	GRAYFORD	B	HADLEY	B
FROST	D	GEARHART	A	GLYNN	C	GRAYLING	A	HADO	B
FRUITA	B	GEARY	B	GOBLE	C	GRAYLOCK	B	HAGEN	B
FRUITLAND	B	GEE	B	GODDARD	B	GRAYPOINT	B	HAGENBARTH	B
FRYE	D	GEEBURG	C	GODDE	D	GRAYS	B	HAGENER	A
FUEGO	C	GEER	C	GODECKE	D	GREAT BEND	B	HAGER	C
FUERA	C	GEFO	A	GODFREY	C	GREELEY	B	HAGERMAN	B
FULDA	C	GELKIE	B	GODWIN	D	GREEN BLUFF	B	HAGERSTOWN	C
FULLERTON	B	GEM	C	GOEGLEIN	C	GREEN CANYON	B	HAGGA	B
FULMER	B/D	GEMID	C	GOESSEL	D	GREENCREEK	B	HAIG	C
FULSHEAR	C	GEMSON	C	GOFF	C	GREENDALE	B	HAIKU	B
FULTON	D	GENESEE	B	GOGEBIC	B	GREENFIELD	B	HAILMAN	B
FUQUAY	B	GENEVA	C	GOLBIN	C	GREENHORN	D	HAINES	B/C
FURNIS	B/D	GENOA	D	GOLCONDA	D	GREENLEAF	B	HAIRE	C
FURY	B/D	GENOLA	B	GOLDENDALE	B	GREENOUGH	C	HALAWA	B
		GEORGEVILLE	B	GOLDFIELD	B	GREENPORT		HALDER	C
GAASTRA.	C	GEORGIA	B	GOLDHILL	B	GREEN RIVER	B	HALE	B
GABALDON	C	GERALD	D	GOLDMAN	C	GREENSBORO		HALEIWA	B
GABICA	D	GERBER	D	GOLDRIDGE	B	GREENSON	C	HALEY	B
GACEY	D	GERIG	B	GOLDRUN	A	GREENTON	C	HALF MOON	B
GADDES	C	GERING	B	GOLDSBORO	C	GREENVILLE	B	HALFORD	A
GADES	C	GERLAND	C	GOLDSTON	C	GREENWATER	A	HALFWAY	D
GADSDEN	D	GERMANIA		GOLDSTREAM	D	GREENWICH	B	HALII	B
GAGE		GERMANY	B	GOLDVALE	C	GREENWOOD	D	HALIIMAILE	B
GAGEBY	B	GESTRIN	B	GOLDVEIN	C	GREER	C	HALIS	B
GAGETOWN	C	GETTA	C	GOLIAD	C	GREGORY	A	HALL	B
GAHEE	B	GETTYS	C	GOLLAHER	A	GRELL	C	HALLECK	B
GAINES	C	GEYSEN	D	GOMEZ	B	GRENADA	C	HALL RANCH	C
GAINESVILLE	A	GHENT	C	GONVICK	B	GRENVILLE	B	HALLVILLE	B
GALATA	D	GIBBLER	C	GOOCH	D	GRESHAM	C	HALSEY	D
GALE	B	GIBBON	B	GOODALE	C	GREWINGK	C	HAMAKUAPOKO	B
GALEN	B	GIBBS	D	GOODING	C	GREYBACK	B	HAMAN	B
GALENA	C	GIBBSTOWN	A	GOODINGTON	C	GREYBULL	C	HAMAR	B
GALEPPI	C	GIFFIN	C	GOODLOW	B	GREYCLIFF	C	HAMBLEN	C
GALESTOWN	A	GIFFORD	C	GOODMAN	B	GRIFFY	B	HAMBRIGHT	D
GALEY	B	GILA	C	GOODRICH	B	GRIGSTON	B	HAMBURG	B
GALISTEO	D	GILBY	B	GOODSPRINGS	D	GRIMSTAD	B	HAMEL	C
GALLAGHER	B	GILCHRIST	B	GOOSE CREEK	B	GRISWOLD	B	HAMERLY	C
GALLATIN	A	GILCREST	B	GOOSE LAKE	C	GRIVER	C	HAMILTON	A
GALLEGOS	B	GILEAD	C	GOOSMUS	B	GRIZZLY	C	HAMLET	B
GALLINA	C	GILES	B	GORDO	C	GROGAN	B	HAMLIN	B
GALLION	B	GILFORD	B/D	GORE	D	GROSECLOSE	C	HAMPDEN	
GALVA	B	GILHOULY	B	GORGONIO	A	GROSS	C	HAMPSHIRE	C
GALVESTON	A	GILISPIE	C	GORHAM	B	GROTON	A	HAMPTON	C
GALVIN	C	GILLIAM	C	GORIN	C	GROVE	A	HAMTAH	C
GAMBLER	A	GILLIGAN	B	GORING	C	GROVELAND	B	HANA	A
GANNETT	D	GILLS	C	GORMAN	B	GROVER	B	HANALEI	C
GANSNER	D	GILMORE	D	GORUS	A	GROVETON	B	HANAMAULU	A
GAPO	D	GILPIN	C	GORZELL	B	GRUBBS	D	HANCEVILLE	B
GAPPMAYER	B	GILROY	C	GOSHEN	B	GRULLA	D	HAND	B
GARA	B	GILSON	B	GOSHUTE	D	GRUMMIT	C	HANDFORD	B
GARBER	B	GILT EDGE	C	GOSPORT	C	GRUNDY	C	HANEY	B
GARBUTT	B	GINAT	D	GOTHAM	A	GRUVER	C	HANGAARD	C
GARCENO	C	GINGER	C	GOTHARD	D	GRYGLA	C	HANGER	B
GARDENA	B	GINI	B	GOTHIC	C	GUADALUPE	B	HANIPOE	B
GARDINER	A	GINSER	C	GOTHO	C	GUAJE	A	HANKINS	C
GARDNERS FORK	B	GIRD	A	GOULDING	D	GUALALA	D	HANKS	B
GARDNERVILLE	D	GIVEN	C	GOVAN	C	GUAMANI	B	HANLY	A
GARDONE	A	GLADDEN	A	GOVE	B	GUANAJIBO	C	HANNA	B
GAREY	C	GLADSTONE	B	GOWEN	B	GUANICA	D	HANOVER	C
GARFIELD	C	GLADWIN	A	GRABE	B	GUAYABO	B	HANS	C
GARITA	C	GLAMIS	C	GRABLE	B	GUAYABOTA	D	HANSEL	C
GARLAND	B	GLANN	B/C	GRACEMONT	B	GUAYAMA	D	HANSKA	C
GARLET	A	GLASGOW	C	GRACEVILLE	B	GUBEN	B	HANSON	A
GARLOCK	C	GLEAN	B	GRACY	D	GUCKEEN	C	HANTHO	B
GARMON	C	GLEASON	C	GRAFTON	B	GUELPH	B	HANTZ	D
GARMORE	B	GLEN	B	GRAHAM	D	GUENOC	C	HAP	B
GARNER	D	GLENBERG	B	GRAIL	C	GUERNSEY	C	HAPGOOD	B
GARO	D	GLENBROOK	D	GRAMM	B	GUERRERO	C	HAPNEY	C
GARR	D	GLENCOE	C	GRANATH	B	GUEST	D	HARBORD	B
GARRARD	B	GLENDALE	B	GRANBY	A/D	GUIN	A	HARBOURTON	
GARRETSON	B	GLENDALE	B	GRANDE RONDE	D	GULER	B	HARCO	B
GARRETT	B	GLENDIVE	B	GRANDFIELD	B	GULKANA	B	HARDEMAN	B
GARRISON	B	GLENOORA	C	GRANDVIEW	C	GUMBOOT	C	HARDESTY	B
GARWIN	C	GLENELG	B	GRANER	C	GUNBARREL	A	HARDING	D

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Table B.1--Continued

HARDSCRABBLE	B	HEBER	B	HILDRETH	D	HONEYGROVE	C	HUMBARGER	B
HARDY	D	HEBERT	C	HILEA	D	HONEYVILLE	C	HUMBIRD	C
HARGREAVE	B	HEBGEN	A	HILES	B	HONN	B	HUMBOLDT	C
HARKERS	C	HEBO	D	HILGER	B	HONOKAA	A	HUMDUN	B
HARKEY	B	HEBRON	C	HILGRAVE	B	HONOLUA	B	HUME	C
HARLAN	B	HECHT	B	HILLEMANN	C	HONOMANU	B	HUMESTON	C
HARLEM	C	HECKI	C	HILLET	D	HONOULIULI	D	HUMMINGTON	C
HARLESTON	C	HECLA	B	HILLFIELD	B	HONUAULU	A	HUMPHREYS	B
HARLINGEN	D	HECTOR	D	HILLGATE	C	HOOD	B	HUMPTULIPS	B
HARMEHL	C	HEDDON	C	HILLIARD	B	HOODLE	B	HUNSAKER	B
HARMONY	C	HEDRICK	B	HILLON	B	HOODSPORT	B	HUNTERS	B
HARNEY	C	HEDVILLE	D	HILLSBORO	B	HOODVIEW	B	HUNTING	C
HARPETH	B	HEGNE	D	HILLSDALE	B	HOOKTON	C	HUNTINGTON	B
HARPS	B	HEIDEN	D	HILMAR	C/D	HOOLEHUA	B	HUNTSVILLE	B
HARPSTER	C	HEIDTMAN	C	HILO	A	HOOPAL	C	HUPP	B
HARPT	B	HEIL	D	HILT	B	HOOPER	D	HURLEY	D
HARQUA	B	HEIMDAL	B	HILTON	B	HOOPESTON	B	HURON	C
HARQUA	B	HEISETON	B	HINCKLEY	A	HOOSIC	A	HURST	D
HARRIET	D	HEISLER	B	HINDES	C	HOOT	D	HURWAL	B
HARRIMAN	B	HEIST	B	HINESBURG	C	HOOTEN	D	HUSE	C
HARRIS	D	HEITT	C	HINKLE	D	HOOVER	B	HUSSA	B/D
HARRISBURG	D	HEITZ	D	HINMAN	C	HOPETON	C	HUSSMAN	D
HARRISON	C	HEIZER	D	HINSDALE		HOPEWELL		HUTCHINSON	C
HARRISVILLE	C	HELOT	C	HINTZE	D	HOPGOOD	C	HUTSON	B
HARSTENE	B	HELEMANO	C	HISLE	D	HOPKINS	B	HUXLEY	D
HART	D	HELENA	C	HITT	B	HOPLEY	B	HYAM	D
HART CAMP	C	HELMER	C	HI VISTA	C	HOPPER	B	HYAT	A
HARTFORD	A	HELVETIA	C	HIWASSEE	B	HOQUIAM	B	HYATTVILLE	B
HARTIG	B	HELY	B	HIWOOD	A	HORATIO	D	HYDABURG	D
HARTLAND	B	HEMBRE	B	HIXTON	B	HORD	B	HYDE	D
HARTLETON	B	HEMMI	C	HOBACKER	B	HOREB	B	HYDRO	C
HARTLINE	B	HEMPFIELD		HOBAN	C	HORNELL	D	HYMAS	D
HARTSBURG	B	HEMPSTEAD	C	HOBBS	B	HORNING	A	HYRUM	B
HARTSELLS	B	HENCRATT	B	HOBSON	C	HORNITOS	D	HYSHAM	C
HARTSHORN	B	HENDERSON	B	HOCHHEIM	B	HORROCKS	B		
HARVARD	B	HENDRICKS	B	HOCKING	B	HORSESHOE	B	IAO	C
HARVEL	B	HENEFER	C	HOCKINSON	C	HORTON	B	IBERIA	D
HARVEY	C	HENKIN	B	HOCKLEY	C	HORTONVILLE	B	ICENE	C
HASKILL	A	HENLEY	C	HODGE	B	HOSKIN	C	IDA	B
HASKINS	C	HENLINE	C	HODGINS	C	HOSLEY	D	IDABEL	B
HASSELL	D	HENNEKE	C	HODGSON	C	HOSMER	C	IDANA	C
HASTINGS	B	HENNEPIN	B	HOEBE	B	HOTAW	C	IDEON	D
HAT	B	HENNINGSEN	C	HOELZLE	C	HOT LAKE	C	IDMON	B
HATBORO	D	HENRY	D	HOFFMAN	C	HOUDEK	B	IGNACIO	B
HATCH	C	HENSEL	B	HOFFMANVILLE	C	HOUGHTON	A/D	IGO	D
HATCHERY	C	HENSHAW	C	HOGANSBURG	B	HOUK	C	IGUALDAD	D
HATFIELD	C	HENSLEY	D	HOGELAND	B	HOULKA	D	IHLEN	D
HATHAWAY	B	HEPLER	D	HOGG	D	HOULTON	C/D	IJAM	C
HATTIE	C	HERBERT	B	HOGRIS	B	HOUNDBY	D	ILDEFONSO	B
HATTON	C	HEREFORD	B	HOH	B	HOURGLASS	B	ILKA	B
HAUBSTADT	C	HERKIMER	B	HOHMANN	C	HOUSATONIC	D	ILLION	B/D
HAVANA	B	HERLONG	D	HOKO	C	HOUSE MOUNTAIN	D	IMA	B
HAVEN	B	HERMISTON	B	HOLBROOK	B	HOUSEVILLE	C	IMBLER	B
HAVERLY	B	HERMON	A	HOLCOMB	D	HOUSTON	D	IMLAY	C
HAVERSON	B	HERNDON	B	HOLDAWAY	D	HOUSTON BLACK	C	IMMOKALEE	B/D
HAVILLAH	B	HERO	B	HOLDEN	A	HOVDE	A/C	IMPERIAL	C
HAVINGDON	C	HERRERA	A	HOLDERNESS	C	HOVEN	D	INAVALE	A
HAVRE	B	HERRICK	C	HOLDREGE	B	HOVENWEEP	C	INDIAHOMA	D
HAVRELON	B	HERRON	B	HOLLAND	B	HOVERT	D	INDIAN	
HAW	B	HERSH	A	HOLLINGER	B	HOVEY	C	INDIAN CREEK	D
HAWES	A	HERSHAL	B/D	HOLLIS	C/D	HOWARD	B	INDIANO	C
HAWI	B	HESCH	B	HOLLISTER	D	HOWELL	C	INDIANOLA	A
HAWKEYE	A	HESPER	C	HOLLOMAN	C	HOWLAND	C	INDIO	B
HAWKSELL	A	HESPERIA	B	HOLLOWAY	A	HOYE	B	INGA	B
HAWKSPRINGS	B	HESPERUS	B	HOLLY	D	HOYLETON	C	INGALLS	B
HAXTUN	A	HESSE	C	HOLLY SPRINGS	D	HOYPUS	A	INGARD	B
HAYBOURNE	B	HESSEL	C	HOLLYWOOD	D	HOYTVILLE	D	INGENIO	C
HAYBRO	C	HESSELBERG	C	HOLMDEL	C	HUBBARD	A	INGRAM	D
HAYDEN	B	HESSELTINE	B	HOLMES	B	HUBER	D	INKLER	B
HAYESTON	B	HESSON	C	HOLOMUA	B	HUBERT	B	INKS	D
HAYESVILLE	B	HETTINGER	D	HOLOPAW	B/D	HUBLERSBURG	C	INMAN	C
HAYFIELD	B	HEXT	B	HOLROYD	B	HUCKLEBERRY	C	INMO	A
HAYFORD	C	HEZEL	B	HOLSINE	B	HUDSON	C	INSKIP	C
HAYMOND	B	HIALEAH	D	HOLST	B	HUECO	C	INVERNESS	D
HAYNESS	D	HIAWATHA	A	HOLSTON	B	HUEL	A	INWOOD	C
HAYNIE	B	HIBBARD	C	HOLT	B	HUENEME	B/C	IO	B
HAYPRESS	A	HIBBING	C	HOLTLE	B	HUERHUERO	D	IOLA	A
HAYSPUR	B/D	HICKORY	C	HOLTVILLE	C	HUEY	D	IOLEAU	C
HAYTER	B	HICKS	B	HOLYOKE	C/D	HUFFINE	A	IONA	B
HAYTI	D	HIDALGO	B	HOMA	C	HUGGINS	C	IONIA	B
HAYWOOD	B	HIDEAWAY	D	HOME CAMP	C	HUGHES	C	IOSCO	B
HAZEL	C	HIDEWOOD	C	HOMELAKE	B	HUGHESVILLE	B	IPAVA	B
HAZELAIR	D	HIGHAMS	D	HOMER	C	HUGO	B	IRA	C
HAZEN	B	HIGHFIELD	B	HOMESTAKE	D	HUICHICA	C	IREDELL	D
HAZLEHURST	C	HIGH GAP	C	HOMESTEAD	B	HUIKAU	A	IRETEBA	C
HAZLETON	B	HIGHLAND	B	HONAUNAU	C	HULETT	B	IRIM	C
HEADLEY	B	HIGHMORE	B	HONCUT	B	HULLS	C	IROCK	B
HEADQUARTERS	B	HIGH PARK	B	HONDALE	D	HULLT	B	IRON BLOSSOM	D
HEAKE	D	HIHIMANU	A	HONDO	C	HULUA	D	IRON MOUNTAIN	D
HEATH	C	HIIBNER	C	HONDOHO	B	HUM	B	IRON RIVER	B
HEATLY	A	HIKO PEAK	B	HONEOYE	B	HUMACAO	B	IRONTON	C
HEBBRONVILLE	B	HIKO SPRINGS	C	HONEY	D	HUMATAS	C	IRVINGTON	C

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Table B .1--Continued

IRWIN	D	JONUS	B	KARLO	D	KERMIT	A	KITSAP	C
ISAAC	C	JOPLIN	B	KARLUK	C	KERR	B	KITTANNING	
ISSAQUAH	B/C	JOPPA	B	KARNAK	D	KERRICK	B	KITTITAS	B
ISABELL	C	JORDAN	D	KARNES	B	KERRTOWN		KITTREDGE	C
ISAN	D	JORNADO	B	KARRO	B	KERSHAW	A	KITTSON	C
ISANTI	D	JORY	C	KARS	A	KERSICK	D	KIUP	B
ISHAM	C	JOSE	C	KARTA	C	KERSTON	A/D	KIVA	B
ISHI PISHI	C	JOSEPHINE	B	KARTAR	B	KERT	C	KIWANIS	A
ISLAND	B	JOSIE	B	KASHWITNA	B	KERWIN	C	KIZHUYAK	B
ISOM	B	JOY	B	KASILOF	A	KESSLER	C	KJAR	D
ISTOKPOGA	D	JUBILEE	C	KASKI	B	KESWICK	D	KLABER	C
ITSWOOT	B	JUDD	D	KASOTA	C	KETCHLY	B	KLAMATH	B/D
IUKA	C	JUDITH	B	KASSLER	A	KETTLE	B	KLAUS	A
IVA	C	JUDKINS	C	KASSON	C	KETTLEMAN	B	KLAWASI	C
IVAN	B	JUDSON	B	KATAMA	B	KETTNER	C	KLEJ	B
IVES	B	JUDY	C	KATEMCY	C	KEVIN	C	KLICKER	C
IVIE	A	JUGET	D	KATO	C	KEWAUNEE	C	KLICKITAT	C
IVINS	C	JUGHANDLE	B	KATHRINE	B	KEWEENAW	A	KLINE	B
IZAGORA	C	JULES	B	KATULA	B	KEYA	B	KLINESVILLE	C/D
IZEE	C	JULESBURG	A	KATY	C	KEYES	D	KLINGER	B
		JULIAETTA	B	KAUFMAN	D	KEYPORT	C	KLONDIKE	D
JABU	C	JUMPE	B	KAUPO	A	KEYTESVILLE	D	KLONE	B
JACAGUAS	B	JUNCAL	C	KAVETT	D	KEZAR	B	KLOOCHMAN	B
JACANA	D	JUNCOS	D	KAWAIHAE	C	KIAWAH	C	KLOTEN	B
JACINTO	B	JUNCTION	B	KAWAIHAPAI	B	KIBBIE	B	KLUTINA	B
JACK CREEK	B	JUNEAU	B	KAWBAWGAM	C	KICKERVILLE	B	KNAPPA	B
JACKLIN	B	JUNIATA		KAWICH	A	KIDD	C	KNEELAND	C
JACKNIFE	C	JUNIUS	C	KAWKAWLIN	C	KIDMAN	B	KNIFFIN	C
JACKS	D	JUNO	B	KEAAU	D	KIEHL	A	KNIGHT	C
JACKSON	B	JUNQUITOS	C	KEAHUA	B	KIEV	B	KNIK	B
JACKSONVILLE	C	JURA	C	KEALAKEKUA	C	KIKONI	B	KNIPPA	D
JACUB	D	JUVA	B	KEALIA	D	KILARC	D	KNOB HILL	B
JACOBSEN	D	JUVAN	D	KEANSBURG	D	KILAUEA	B	KNOWLES	B
JACOBY	C			KEARNS	B	KILBOURNE	A	KNOX	B
JACQUES	C	KAALUALU	A	KEATING	C	KILBURN	A	KNULL	B
JACQUITH	C	KACHEMAK	B	KEAUKAHA	D	KILCHIS	C	KNUTSEN	A
JACWIN	B	KADASHAN	B	KEAWAKAPU	B	KILDOR	C	KOBAR	C
JAFFREY	A	KADE	C	KEBLER	B	KILGORE	B/D	KOCH	C
JAGUEYES	B	KADOKA	B	KECH	C	KILKENNY	B	KODAK	C
JAL	B	KAUCKA	B	KECKO	B	KILLBUCK	C/D	KODIAK	B
JAMES CANYON	B/C	KAENA	D	KEDRON	C	KILLEY	B	KOEHLER	C
JAMESTOWN	C	KAHALUU	D	KEEFERS	C	KILLINGWORTH		KOELE	B
JANE	C	KAHANA	B	KEEGAN		KILLPACK	C	KOEPKE	B
JANISE	C	KAHANUI	B	KEEI	D	KILMERQUE	C	KOERLING	B
JANSEN	A	KAHLER	B	KEEKEE	B	KILOA	A	KOGISH	D
JARBOE	C	KAHOLA	B	KEENE	C	KILCHANA	A	KOHALA	A
JARITA	C	KAH SHEETS	D	KEENO	C	KILWINNING	C	KOKEE	B
JARRE	B	KAHUA	D	KEG	B	KIM	B	KOKO	B
JARVIS	B	KAIKLI	D	KEHENA	C	KIMAMA	B	KOKOKAHI	D
JASPER	B	KAILUA	A	KEIGLEY	C	KIMBALL	C	KOKOMO	B/D
JAUCAS	A	KAIMU	A	KEISER	B	KIMBERLY	B	KOLBERG	B
JAVA	B	KAINALIU	A	KEITH	B	KIMBROUGH	C	KOLEKOLE	C
JAY	C	KAIPOIOI	B	KEKAHA	B	KIMMERLING	C	KOLLS	D
JAYEM	B	KAIWIKI	A	KEKAKE	D	KIMO	C	KOLOA	C
JAYSON	D	KALAE	B	KELLER	C	KINA	D	KOLOKOLO	B
JEAN	A	KALAMA	C	KELLY	D	KINCO	A	KONA	D
JEANERETTE	C	KALAMAZOO	B	KELN	C	KINGFISHER	B	KONAWA	B
JEAN LAKE	B	KALAPA	B	KELSEY	C	KINGHURST	B	KONNER	C
JEDDO	D	KALAUPAPA	D	KELSO	C	KINGMAN	C	KONOKTI	C
JEFFERSON	B	KALIFONSKY	C	KELTNER	B	KINGS	C/D	KOOLAU	C
JEKLEY	C	KALIHI	D	KELVIN	C	KINGSBURY	D	KOOSKIA	C
JELM	D	KALISPELL	A	KEMOO	B	KINGSLEY	B	KOOTENAI	A
JENKINS	B	KALKASKA	A	KEMPSVILLE	B	KINGS RIVER	C	KOPIAH	C
JENKINSON	D	KALMIA	B	KEMPTON	B	KINGSTON	B	KOPP	B
JENNESS	B	KALOKO	D	KENAI	C	KINGSVILLE	C	KOPPES	B
JENNINGS	C	KALOLOCH	E	KENANSVILLE	A	KINKEAD	D	KORCHEA	B
JENNY	D	KALSIN	C	KENDAIA	C	KINKEL	B	KORNMAN	B
JERAULD	D	KAMACK	B	KENDALL	B	KINKORA	D	KOSMOS	C
JERICHO	C	KAMAKOA	A	KENDALLVILLE	B	KINMAN	C	KOSSE	D
JEROME	B	KAMAOA	B	KENESAW	B	KINNEY	B	KOSTER	C
JERRY	C	KAMAOLE	B	KENMOOR	B	KINNICK	C	KOSZTA	B
JESBEL	D	KAMRAR	B	KENNALLY	B	KINREAD	D	KOUTS	B
JESSE CAMP	C	KANABEC	B	KENNAN	B	KINROSS	D	KOVICH	C
JESSUP	C	KANAKA	B	KENNEBEC	B	KINSTON	C	KOYEN	B
JETT	B	KANAPAHA	A/D	KENNEDY	B	KINTON	C	KOYUKUK	B
JIGGS	C	KANDIK	B	KENNEWICK	B	KINZEL	B	KRADE	B
JIM	C	KANE	B	KENNEY	A	KIONA	B	KRANZBURG	B
JIMENEZ	C	KANEOHE	B	KENNEY LAKE	C	KIPLING	D	KRATKA	C
JIMTOWN	C	KANEPUU	B	KENO	D	KIPP	C	KRAUSE	A
JOB	C	KANLEE	B	KENOMA	D	KIPPEN	B	KREAMER	
JOBOS	C	KANOSH	C	KENSAL	B	KIPSON	C	KREMLIN	B
JOCITY	B	KANZA	C	KENSPUR	A	KIRK	B/D	KRENTZ	B
JOEL	B	KAPAA	A	KENT	D	KIRKHAM	C	KRESSON	C
JOES	B	KAPAPALA	B	KENYON	C	KIRKLAND	D	KRUM	D
JOHNS	C	KAPCO	B	KEO	B	KIRKTON	B	KRUSE	B
JOHNSBURG	D	KAPOWSIN	B	KEOLDAR	B	KIRTLEY	B	KRUZOF	B
JOHNSON	B	KAPUHIKANI	D	KEOMAH	C	KIRVIN	C	KUBE	B
JOHNSTON	B/D	KARAMIN	B	KEOTA	C	KISRING	D	KUBLER	C
JOHNSWOOD	B	KARDE	C	KEOWNS	D	KISSICK	D	KUBLI	C
JOICE	D	KARHEEN	D	KEPLER	C	KISTLER	C/D	KUCERA	B
JOLIET	C	KARLAN	C	KERBY	B	KITCHELL	B	KUCK	C
JONESVILLE	A	KARLIN	A	KERMEL	B	KITCHEN CREEK	B	KUHL	D

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Table B.1--Continued

KUKAIAU	A	LANE	C	LEADVILLE	B	LICKDALE	D	LOLAK	D
KULA	B	LANEY	B	LEAF	D	LICKING	C	LOLALITA	B
KULAKALA	B/C	LANG	B/D	LEAHY	B	LICKSKILLET	D	LOLEKAA	B
KULLIT	B	LANGFORD	C	LEAL	B	LIDDELL	D	LOLETA	C/D
KUMA	B	LANGHEI	B	LEAPS	C	LIEBERMAN	C	LOLO	A
KUNIA	B	LANGLEY	C	LEATHAM	C	LIEN	D	LOLON	A
KUNUWEIA	C	LANGLOIS	D	LEAVENWORTH	B	LIGGET	B	LOMA	C
KUKO	D	LANGOLA	B	LEAVITT	B	LIGHTNING	D	LOMALTA	D
KUSKOKWIM	D	LANGRELL	B	LEAVITTVILLE	B	LIGNUM	C	LOMAX	B
KUSLINA	D	LANGSTON	C	LEBANON	C	LIGON	D	LOMIRA,	B
KUTCH	D	LANIER	B	LEBAR	B	LIHEN	A	LONDO	C
KUTZTOWN	B	LANIGER	B	LEBEC	B	LIHUE	B	LONEPINE	C
KVICHAK	B	LANKBUSH	B	LEBO	C	LIKES	A	LONERIDGE	B
KYLE	D	LANKIN	C	LEBSACK	C	LILAH	A	LONE ROCK	A
KYLER	D	LANKTREE	C	LECK KILL	B	LILLIWAUP	A	LONETREE	B
		LANOAK	B	LEDBEDER	B	LIMA	B	LONGFORD	C
LA BARGE	B	LANSDALE	B	LEDGEFORK	A	LIMANI	B	LONGLOIS	B
LABETTE	C	LANSDOWNE		LEDGER	C	LIMBAR	B	LONGMARE	B
LABISH	D	LANSING	B	LEDRU	D	LIMERICK	C	LONGMONT	C
LA BOUNTY	C	LANTIS	B	LEDY		LIMON	C	LONGRIE	C
LA BRIER	C	LANTON	C	LEE	D	LIMONES	B	LONGVAL	B
LACAMAS	C/D	LANTONIA	B	LEEDS	C	LINCOLN	A	LONG VALLEY	B
LA CASA	C	LANTZ	C	LEEFIELD	C	LINCROFT	A	LONGVIEW	C
LACITA	C	LAP	D	LEELANAU	A	LINDLEY	C	LONOKE	B
LACKAWANNA	C	LAPALMA	C	LEEPER	D	LINDSEY	D	LONTI	C
LACONA	C	LAPEER	B	LEESVILLE	B/C	LINDSIDE	C	LOOKOUT	C
LACOTA	D	LAPINE	A	LEETON	C	LINDSTROM	B	LOON	B
LACY	D	LAPLATTA	C	LEETONIA	C	LINDY	C	LOPER	B
LADD	B	LAPORTE	C	LEFOR	B	LINEVILLE	C	LOPEZ	D
LADDER	D	LA POSTA	A	LEGLER	B	LINGANORE	B	LORADALE	C
LADELLE	B	LA PRAIRIE	B	LEGORE	B	LINKER	B	LORAIN	C/D
LADOGA	C	LARABEE	B	LEHEW	C	LINKVILLE	B	LORDSTOWN	C
LADUE	C	LARCHMOUNT	B	LEHIGH	C	LINNE	C	LORELLA	D
LADYSMITH	D	LARDELL	C	LEHMANS	D	LINNET	D	LORENZO	A
LA FARGE	B	LAREDO	B	LEHR	B	LINNEUS	B	LORETTO	B
LAFE	D	LARES	C	LEICESTER	C	LINO	C	LORING	C
LA FONDA	C	LARGENT	D	LEILEHUA	B	LINSLAW	D	LOS ALAMOS	C
LAFONT	B	LARGO	C	LELA	D	LINT	B	LOS BANOS	C
LAGLORIA	B	LARIMER	B	LELAND	D	LINTON	B	LOSEE	B
LAGONDA	C	LARKIN	B	LEMETA	D	LINVILLE	B	LOS GATOS	B
LA GRANDE	C	LARKSON	C	LEMPSTER	C/D	LINWOOD	A/D	LOS GUINEOS	C
LAHAINA	B	LA ROSE	B	LEN	C	LIPAN	D	LOS OSOS	C
LA HOGUE	B	LARRY	D	LENA	A	LIPPINCOTT	B/D	LOS ROBLES	B
LAHONTAN	D	LARSON	D	LENAPAH	D	LIRIOS	B	LOS TANOS	B
LAIDIG	C	LARUE	A	LENAWEE	B/D	LIRRET	D	LOST CREEK	B
LAIDLAW	B	LARVIE	D	LENNEP	D	LISADE	B	LOST HILLS	C
LAIRDSVILLE	D	LAS	C	LENOIR	D	LISAM	C	LOS TRANCOS	D
LAIREP	D	LAS ANIMAS	C	LENOX	B	LISBON	B	LOSTWELLS	B
LA JARA	C	LASAUSSES	C	LENZ	B	LISMAS	D	LOTHAIR	C
LAKE	A	LAS FLORES	D	LEO	B	LISMORE	B	LOTUS	B
LAKE CHARLES	D	LASHLEY		LEON	A/D	LITCHFIELD	A	LOUDON	C
LAKE CREEK	B	LASIL	C	LEONARD	C	LITHGOW	C	LOUDONVILLE	C
LAKEHELEN	B	LAS LUCAS	C	LEONARDO	B	LITHIA	C	LOUIE	C
LAKEHURST	A	LAS POSAS	C	LEONARDTOWN	D	LITIMBER	C	LOUISA	B
LAKE JANEE	A	LASSEN	D	LEONIDAS	B	LITLE	D	LOUISBURG	B
LAKELAND	A	LASTANCE	B	LEOTA	C	LITTLEBEAR	A	LOUP	D
LAKEMONT	D	LAS VEGAS	D	LEPLEY	D	LITTLEFIELD	D	LOURDES	C
LAKEPORT	B	LATAH	C	LERDAL	C	LITTLE POLE	D	LOUVIERS	D
LAKESHORE	D	LATAHCO	C	LEROY	B	LITTLETON	B	LOVEJOY	C
LAKESOL	B	LATANIER	D	LESHARA	B	LITTLE WOOD	B	LOVELAND	C
LAKETON	B	LATHAM	D	LESHO	C	LITZ	C	LOVELL	C
LAKEVIEW	C	LATINA	D	LESLIE	D	LIVERMORE	A	LOVELOCK	C/C
LAKEWIN	A	LATOM	D	LESTER	B	LIVINGSTON	D	LOWELL	C
LAKEWOOD	A	LATONIA	B	LE SUEUR	B	LIVONA	A	LOWRY	B
LAKI	B	LATTY	C	LETA	C	LIZE	C	LOWVILLE	B
LAKIN	A	LAUDERDALE	B	LETCHER	D	LIZZANT	B	LOYAL	B
LAKOMA	D	LAUGENOUR	B/D	LETHA	D	LOBDELL	C	LOYALTON	D
LALAAU	A	LAUGHLIN	B	LETHENT	C	LOBELVILLE	C	LOYSVILLE	D
LA LANDE	C	LAUMAIA	B	LETORT		LOBERG	B	LOZANO	B
LALLIE	D	LAUREL	C	LETTERBOX	B	LOBERT	B	LOZIER	D
LAM	B/D	LAURELHURST	C	LEVAN	A	LOBITOS	C	LUALUALEI	D
LAMAR	B	LAURELWOOD	B	LEVASY	C	LOCEY	C	LUBBOCK	C
LAMARTINE	B	LAUREN	B	LEVERETT	C	LOCHSA	B	LUBRECHT	C
LAMBERT	B	LAVALLEE	B	LEVIATHAN	B	LOCKE	B	LUCAS	C
LAMBETH	C	LAVEEN	B	LEVIS	C	LOCKERBY	C	LUCE	C
LAMINGTON	D	LAVELDO	D	LEWIS	D	LOCKHARD	B	LUCEDALE	B
LAMO	B	LAVERKIN	C	LEWISBERRY	B	LOCKHART	B	LUCERNE	B
LAMONI	D	LAVINA	C	LEWISBURG	C	LOCKPORT	D	LUCIEN	C
LAMONT	A	LAWAI	B	LEWISTON	C	LOCKWOOD	B	LUCILE	B
LAMONTA	D	LAWLER	B	LEWISVILLE	C	LOCUST	C	LUCILETON	B
LAMOURE	C	LAWRENCE	C	LEX	B	LODAR	D	LUCKY	B
LAMPHIER	B	LAWRENCEVILLE	C	LEXINGTON	B	LODEMA	A	LUCKY STAR	B
LAMPSHIRE	D	LAWSON	B	LIBBINGS	D	LODI	C	LUCY	A
LAMSON	D	LAWTHER	D	LIBBY	B	LODO	D	LUDDEN	D
LANARK	B	LAWTON	C	LIBEG	A	LOFFTUS	C	LUDLOW	C
LANCASTER	B	LAX	C	LIBERAL	D	LOFTON	D	LUFKIN	D
LANCE	B	LAYCOCK	B	LIBERTY	C	LOGAN	C	LUHON	B
LAND	D	LAYTON	A	LIBORY	A	LOGGERT	A	LUJANE	C
LANDES	B	LEA	C	LIBRARY	D	LOGY	B	LUKIN	C
LANDISBURG	C	LEADER	B	LIBUTTE	D	LOHLER	C	LULA	B
LANDLOW	C	LEADPOINT	B	LICK	B	LOHMILLER	C	LUMBEE	D
LANDUSKY	D	LEADVALE	C	LICK CREEK	D	LOHNES	A	LUMMI	B/C

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Table B.1--Continued

LUN	C	MALABAR	A/D	MARKSBORO		MAYFLOWER	C	MCVICKERS	C
LUNA	C	MALABON	C	MARLA	A	MAYHEW	D	MEAD	D
LUNCH	C	MALACHY	B	MARLBORO	B	MAYLAND	B	MEADIN	A
LUNDIMO	C	MALAGA	B	MARLEAN	B	MAYMEN	C	MEADOWVILLE	B
LUNDY	B	MALAMA	A	MARLETTE	B	MAYNARD LAKE	B	MEADVILLE	
LUNI	C	MALAYA	D	MARLEY	B	MAYO	B	MEANDER	D
LUPTON	D	MALCOLM	B	MARLIN	D	MAYODAN	B	MECAN	B
LURA	D	MALEZA	B	MARLOW	C	MAYOWORTH	D	MECCA	B
LURAY	C/D	MALIBU	D	MARLTON	C	MAYSDORF	B	MECKESVILLE	C
LUTE	D	MALIN	C/D	MARMARTH	B	MAYSVILLE		MECKLENBURG	C
LUTH	C	MALJAMAR	A	MARNA	D	MAYTOWN	C	MEDA	B
LUTHER	B	MALLOT	A	MARPA	B	MAYVILLE	B	MEDANO	C
LUTIE	B	MALM	C	MARQUETTE	A	MAYWOOD	B	MEDARY	C
LUTON	D	MALO	B	MARR	B	MAZEPPA	B	MEDFORD	B
LUVERNE	C	MALONE	B	MARRIOTT	B	MAZON	C	MEDFRA	D
LUXOR	C	MALOTERRE	D	MARSDEN	C	MAZUMA	C	MEDICINE LODGE	B
LUZENA	D	MALPAIS	C	MARSELL	B	MCAFEE	C	MEDINA	B
LYCAN	B	MALPOSA	C	MARSHALL	B	MCALLEN	B	MEDWAY	B
LYCOMING	C	MALVERN	C	MARSHAN	D	MCALLISTER	C	MEEKS	A
LYDICK	B	MAMALA	D	MARSHDALE	C	MCALPIN	C	MEETEETSE	C
LYFORD	C	MAMOU	C	MARSHFIELD	C	MCBEE	B	MEGGETT	D
LYLES	B	MANAHAA	C	MARSING	B	MCBETH	C	MEGON	C
LYMAN	C/D	MANALAPAN		MART	C	MCBRIDE	B	MEHL	C
LYNCH	D	MANANA	C	MARTELLA	B	MCCABE	B	MEHLHORN	C
LYNCHBURG	B/D	MANASSA	C	MARTIN	C	MCCAFFERY	A	MEIGS	
LYNDEN	A	MANASSAS	B	MARTINA	A	MCCAIN	C	MEIKLE	D
LYNNDYL	A	MANASTASH	C	MARTINECK	D	MCCALEB	B	MEISS	D
LYNN HAVEN	B/D	MANATEE	B/D	MARTINEZ	D	MCCALLY	D	MELBOURNE	B
LYNNVILLE	C	MANAWA	C	MARTINI	B	MCCAMMON	C	MELBY	C
LYNX	B	MANCELONA	A	MARTINSBURG	B	MCCARRAN	D	MELITA	B
LYONMAN	C	MANCHESTER	A	MARTINSDALE	B	MCCARTHY	B	MELLENTHIN	D
LYONS	D	MANDAN	B	MARTINSON	C	MCCLAVE	C	MELLOR	D
LYONSVILLE	B	MANDERFIELD	B	MARTINSVILLE	B	MCCLEARY	C	MELLOTT	B
LYSINE	D	MANDEVILLE	B	MARTINTON	C	MCCLELLAN	B	MELOLAND	C
LYSTAIR	B	MANFRED	D	MARTY	B	MCCLOUD	C	MELROSE	C
LYTELL	B	MANGUM	D	MARVAN	D	MCCOIN	D	MELSTONE	A
		MANHATTAN	A	MARVIN	C	MCCOLL	D	MELTON	B
MABEN	C	MANHEIM	C	MARY	C	MCCONNEL	B	MELVILLE	B
MABI	D	MANI	C	MARYDEL	B	MCCOOK	B	MELVIN	D
MABRAY	D	MANILA	C	MARYSLAND	D	MCCORNICK	C	MEMALOOSE	D
MACAY	B	MANISTEE	B	MASADA	C	MCCOY	C	MEMPHIS	B
MACEDONIA	C	MANITOU	C	MASCAMP	D	MCCREE	B	MENAHGA	A
MACHETE	C	MANLEY	B	MASCOTTE	D	MCCRORY	D	MENAN	C
MACHIAS	B	MANLIUS	C	MASHEL	B	MCCROSKIE	D	MENARD	B
MACK	C	MANLOVE	B	MASHULAVILLE	B/D	MCCULLOUGH	C	MENCH	C
MACKEN	D	MANNING	B	MASON	B	MCCULLY	C	MENDEBOURE	C
MACKINAC	B	MANOR	B	MASONVILLE	C	MCCUNE	D	MENDOCINO	B
MACKSBURG	B	MANSFIELD		MASSACK	B	MCCUTCHEN	C	MENDON	B
MACOMB	B	MANSIC	B	MASSENA	C	MCDOLE	B	MENDOTA	B
MACOMBER	B	MANSKER	B	MASSILLON	B	MCDONALD	B	MENEFEE	D
MACON	B	MANTACHIE	C	MASTERSON	B	MCDONALDSVILLE	C	MENFRO	B
MACY	B	MANTEO	C/D	MATAMOROS	C	MCEWEN	B	MENLO	D
MADALIN	D	MANTER	B	MATANUSKA	C	MCFADDEN	B	MENO	C
MADAWASKA	B	MANTON	B	MATANZAS	B	MCFAIN	C	MENCKEN	C
MADDOCK	A	MANTZ	B	MATAPEAKE	B	MCFAUL	C	MENOMINEE	B
MADDOX		MANU	C	MATAWAN	C	MCGAFFEY	C	MENTO	C
MADELIA	C	MANVEL	C	MATCHER	A	MCGARY	C	MENTOR	B
MADELINE	D	MANWOOD	D	MATFIELD	C	MCGEHEE	C	MEQUON	C
MADERA	D	MANZANITA	C	MATHERS	B	MCGILVERY	D	MERCED	C/D
MADISON	B	MANZANO	C	MATHERTON	B	MCGINTY	B	MERCEDES	D
MADONNA	C	MANZANOLA	C	MATHESON	B	MCGIRK	C	MERCER	C
MADRAS	C	MAPES	C	MATHEWS		MCGOWAN	B	MERCEY	C
MADRID	B	MAPLE MT.	B	MATHISTON	C	MCGRATH	B	MEREDITH	B
MADUREZ	B	MAPLETON	C/D	MATLOCK	D	MCGREW	A	MERETA	C
MAGALLON	B	MARATHON	B	MATMON	D	MCHENRY	B	MERGLE	B
MAGENS	B	MARBLE	A	MATTAPEX	C	MCILWAINE	A	MERIDIAN	B
MAGINNIS	C	MARBLEMOUNT	B	MATTOLE	C	MCINTOSH	B	MERINO	D
MAGNA	D	MARCETTA	A	MAUDE	B	MCINTYRE	B	MERKEL	B
MAGNOLIA	B	MARCUM	B	MAUGHAN	C	MCKAMIE	D	MERLIN	D
MAGNUS	C	MARCUS	C	MAUKEY	C	MCKAY	D	MERMILL	B/D
MAGUAYO	D	MARCY	D	MAUMEE	A/D	MCKENNA	C/D	MERNA	C
MAHAFFY	C/D	MARDEN	C	MAUNABO	D	MCKENZIE	D	MEROS	A
MAHALA	C	MARDIN	C	MAUPIN	C	MCKINLEY	C	MERRIFIELD	B
MAHALASVILLE	B/D	MARENGO	C/D	MAUREPAS	D	MCKINNEY	D	MERRILL	C
MAHANA	B	MARESUA	B	MAURINE	D	MCLAIN	C	MERRILLAN	C
MAHASKA	B	MARGERUM	B	MAURY	B	MCLAURIN	B	MERRIMAC	A
MAHER	C	MARGUERITE	B	MAVERICK	C	MCLEAN	C	MERRITT	B/C
MAHONING	D	MARIA	B/C	MAVIE	D	MCLEOD	B	MER ROUGE	B
MAHUKONA	B	MARIANA	C	MAWAE	A	MCMAHON	C	MERTON	B
MAIDEN	B	MARIAS	D	MAX	B	MCMEEN	C	MERTZ	
MAILE	A	MARICAO	B	MAXEY	C	MCMULLIN	C	MESA	B
MAJADA	B	MARICOPA	B	MAXFIELD	C	MCMURDIE	C	MESCAL	C
MAKAALAE	B	MARIETTA	C	MAXSON	A	MCMURPHY	B	MESCALERO	C
MAKALAPA	D	MARILLA	C	MAXTON	B	MCMURRAY	D	MESITA	C
MAKAPILI	A	MARINA	A	MAXVILLE	A	MCNARY	D	MESKILL	C
MAKAWAO	B	MARION	D	MAXWELL	D	MCPAUL	B	MESMAN	C
MAKAWELI	B	MARIPOSA	C	MAY	B	MCPHERSON	C	MESSER	C
MAKENA	B	MARISSA	C	MAYBERRY	C	MCPHIE	B	MET	D
MAKIKI	B	MARKES	D	MAYBESO	C	MCQUARRIE	D	METALINE	B
MAKOTI	C	MARKEY	D	MAY DAY	D	MCQUEEN	C	METAMORA	B
MAL	B	MARKHAM	C	MAYER	D	MCRAE	B	METEA	B
MALA	B	MARKLAND	C	MAYFIELD	B	MCTAGGART	B	METIGOSHE	A

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TWO SOIL GROUPS SUCH AS B/C INDICATES THE DRAINED/UNDRAINED SITUATION

Table B.1--Continued

METOLIUS	B	MISSION	B	MORGANFIELD	B	NABESNA	C	NESS	D
METRE	D	MITCH	B	MORGNEC		NACEVILLE	C	NESSEL	B
METZ	A	MITCHELL	B	MORIARTY	D	NACHES	B	NESSOPAH	B
MEXICO	D	MITIWANGA	C	MORICAL	C	NACIMIENTO	C	NESTER	C
MHOON	D	MIZPAH	C	MORLEY	C	NACOGDOCHES	B	NESTUCCA	C
MIAMI	B	MOANO	D	MORMON MESA	C	NADEAN	B	NETARTS	A
MIAMIAN	C	MOAPA	D	MOROCCO	A/C	NADINA	B	NETO	B
MICCO	A/D	MOAULA	A	MORONI	D	NAFF	B	NETTLETON	C
MICHELSON	B	MOBEETIE	B	MOROP	C	NAGEESI	B	NEUBERT	B
MICHIGAMME	C	MOCA	D	MORRILL	B	NAGITSY	C	NEUNS	B
MICK	B	MOCHO	B	MORRIS	C	NAGLE	B	NEUSKE	B
MIDAS	D	MODA	D	MORRISON	B	NAHMA	C	NEVADOR	C
MIDDLE	C	MODALE	C	MORROW	C	NAHUNTA	C	NEVILLE	B
MIDDLEBURY	B	MODEL	C	MORSE	D	NAIWA	B	NEVIN	C
MIDESSA	B	MODENA	B	MORTENSON	C	NAKAI	B	NEVINE	B
MIDLAND	D	MODESTO	C	MORTON	B	NAKNEK	D	NEVOYER	D
MIDNIGHT	C	MODOC	C	MORVAL	C	NAMBE	B	NEVTAH	C
MIDVALE	C	MOENKOPIE	D	MOSBY	C	NANAMKIN	A	NEVU	D
MIDWAY	D	MOFFAT	B	MOSCA	A	NANCY	B	NEWARK	C
MIFFLIN	B	MOGOLLON	B	MOSEL	C	NANNY	B	NEWART	B
MIFFLINBURG	B	MOGUL	B	MOSHANNON	B	NANNYTON	B	NEWAYGO	B
MIGUEL	C	MOHAVE	B	MOSHER	D	NANSENE	B	NEWBERG	B
MIKE	D	MOHAVE	B	MOSHERVILLE	C	NANTUCKET	C	NEWBERRY	C
MIKESELL	C	MOHAWK	B	MOSIDA	B	NANUM	C	NEWBY	B
MILACA	B	MOIRA	C	MOSQUET	D	NAPA	D	NEW CAMBRIA	C
MILAN	B	MOKELUMNE	D	MOSSYROCK	B	NAPIER	B	NEW CASTLE	B
MILES	B	MOKENA	C	MOTA	B	NAPLES	B	NEWCOMB	A
MILFORD	C	MOKULEIA	B	MOTTSVILLE	A	NAPPANEE	D	NEWDALE	B
MILHAM	C	MOLAND	B	MOULTON	B	NAPTOWNE	B	NEWELL	B
MILHEIM	C	MOLCAL	B	MOUND	C	NARANJITO	C	NEWELLTON	D
MILL	B	MOLENA	A	MOUNTAINBURG	D	NARANJO	C	NEWFANE	
MILLARD	B	MOLINOS	B	MOUNTAINVIEW	B/D	NARCISSE	B	NEWFORK	D
MILLBORO	D	MOLLY	B	MOUNTAINVILLE	B	NARD	B	NEWKIRK	B
MILLBROOK	B	MOLOKAI	B	MOUNT AIRY	A	NARLON	C	NEWLANDS	B
MILLBURNE	B	MOLSON	B	MOUNT CARROLL	B	NARON	B	NEWLIN	B
MILLCREEK	B	MOLYNEUX	B	MOUNT HOME	B	NARRAGANSETT	B	NEWMARKET	B
MILLER	D	MONAD	A	MOUNT HOOD	B	NARROWS	D	NEWPORT	C
MILLERLUX	D	MONAHAN	C	MOUNT LUCAS	C	NASER	B	NEWRY	B
MILLERTON	D	MONAHANS	B	MOUNT OLIVE	D	NASH	B	NEWSKAH	B
MILLETT	B	MONARDA	D	MOUNTVIEW	B	NASHUA	A	NEWSTEAD	D
MILLGROVE	B/D	MONCLOVA	B	MOVILLE	C	NASHVILLE	B	NEWTON	A/D
MILL HOLLOW	B	MONDAMIN	C	MOWATA	D	NASON	C	NEWTONIA	B
MILLICH	D	MONDOVI	B	MOWER	C	NASSAU	C/D	NEWTOWN	C
MILLINGTON	B	MONEE	D	MOYINA	D	NASSET	B	NEWVILLE	C
MILLIS	C	MONICO	B	MUCARA	D	NATALIE	C	NEZ PERCE	C
MILLRACE	B	MONIDA	B	MUCET	C	NATCHEZ	B	NIAGARA	C
MILLSAP	C	MONITEAU	D	MUDRAY	D	NATHROP	B	NIART	B
MILLSDALE	B/D	MONMOUTH	C	MUD SPRINGS	C	NATIONAL	B	NIBLEY	C
MILLSHOLM	C	MONO	D	MUGHOUSE	C	NATRONA	B	NICHOLSON	C
MILLVILLE	B	MONOLITH	C	MUIR	B	NATURITA	B	NICHOLVILLE	C
MILLWOOD	D	MONONA	B	MUIRKIRK	B	NAUKATI	D	NICKEL	B
MILNER	C	MONONGAHELA	C	MUKILTEO	D	NAUMBURG	C	NICKLE	B
MILPITAS	C	MONROE	B	MULCROW	D	NAVAJO	D	NICODEMUS	B
MILROY	D	MONROEVILLE	C/D	MULKEY	C	NAVAN	D	NICOLAUS	C
MILTON	C	MONSE	B	MULLINS	D	NAVARRO	B	NICOLLET	B
MIMBRES	C	MONSERATE	C	MULT	C	NAVESINK		NIELSEN	D
MIMOSA	C	MONTAGUE	D	MULTORPOR	A	NAYLOR		NIGHTHAWK	B
MINAM	B	MONTALTO	C	MUMFORD	B	NAZ	B	NIHILL	B
MINATARE	D	MONTARA	D	MUNDELEIN	B	NEAPOLIS	B/D	NIKISHKA	B
MINCHEY	B	MONTAUK	C	MUNISING	B	NEBEKER	C	NIKLASON	B
MINCO	B	MONTCALM	A	MUNK	C	NEBISH	B	NIKOLAI	D
MINDALE	B	MONTE CRISTO	D	MUNSON	D	NEBO		NILAND	C
MINDEGO	B	MONTEGRANDE	D	MUNUSCONG	D	NECHE	C	NILES	C
MINDEMAN	B	MONTELL	D	MUROC	B	NEDERLAND	B	NIMROD	C
MINDEN	C	MONTELLO	C	MURDOCK	C	NEEDHAM	D	NINCH	C
MINE	B	MONTEVALLO	D	MUREN	B	NEEDLE PEAK	C	NINEMILE	D
MINEOLA		MONTGOMERY	D	MURRILL	B	NEEDMORE	C	NINEVEH	B
MINER	D	MONTICELLO	B	MUSCATINE	B	NEELEY	B	NINIGRET	B
MINERAL	A	MONTIETH	A	MUSE	C	NEGITA	B	NININGER	B
MINERAL MT.	C	MONTMORENCI	B	MUSELLA	B	NEGLEY	B	NINNESCAH	B
MINERVA	B	MONTOSA	C	MUSICK	B	NEHALEM	B	NIOBELL	C
MING	B	MONTOUR	D	MUSINIA	B	NEILTON	A	NIOTA	D
MINGO	B	MONTOYA	D	MUSKINGUM	C	NEISSON	B	NIPE	B
MINIDOKA	C	MONTPELLIER	C	MUSKOGEE	C	NEKIA	C	NIPPERSINK	B
MINNEISKA	C	MONTROSE	B	MUSSELSHELL	B	NELLIS	B	NIPSUM	C
MINNEOSA	A	MONTVALE	D	MUSSEY	D	NELSCOTT	B	NIRA	B
MINNEQUA	B	MONTVERDE	A/D	MUSTANG	A/D	NELSON	B	NISENA	C
MINNETONKA	D	MONTWELL	C	MUTNALA	B	NEMAH	C	NISHON	D
MINNEWAUKAN	B	MOODY	B	MUTUAL	B	NENANA	B	NISQUALLY	A
MINNIECE	D	MOOHOO	B	MYAKKA	A/D	NENNO	B	NISSWA	B
MINOA	C	MOOSE RIVER	C	MYATT	B/D	NEOLA	D	NIU	B
MINORA	C	MORA	B	MYERS	D	NEOTOMA	B	NIULII	C
MINTO	B	MORADO	C	MYERSVILLE	B	NEPESTA	C	NIVLOC	D
MINU	D	MORALES	C	MYLREA	B	NEPHI	B	NIWOT	C
MINVALE	B	MORD	C	MYRICK	D	NEPPEL	B	NIXA	C
MIRABAL	C	MOREAU	C	MYRTLE	B	NEPTUNE	A	NIXON	B
MIRACLE	B	MOREHEAD	C	MYSTEN	A	NERESON	B	NIXONTON	B
MIRAMAR	B	MOREHOUSE	C	MYSTIC	D	NESDA	A	NIZIAN	A
MIRANDA	D	MORELAND	D	MYTON	B	NESHAMINY	B	NOBLE	B
MIRES	B	MORELANDTON	A			NESIKA	B	NOBSCOTT	A
MIRROR	B	MOREY	C	N-BAR	B	NESKOWIN	B	NODAWAY	B
MIRROR LAKE	A	MORFITT	B	NAALEHU	B	NESPELEM	B	NOEL	D

NOTES A BLANK HYDROLOGIC SOIL GROUP INDICATES THE SOIL GROUP HAS NOT BEEN DETERMINED
TWO SOIL GROUPS SUCH AS B/C INDICATES THE DRAINED/UNDRAINED SITUATION

Table B.1--Continued

NOHILI	D	OCILLA	C	ONSLOW	B	OWOSSO	B	PARALOMA	C
NOKASIPPI	D	OCKLEY	B	ONTARIO	B	OWYHEE	B	PARAMORE	D
NOKAY	C	OCOEE	A/D	ONTKO	B/D	OXALIS	C	PARASOL	B
NOKOMIS	B	OCONEE	C	ONTONAGON	D	OXBOW	C	PARCELAS	D
NOLAM	B	OCONTO	B	ONYX	B	OXERINE	C	PARDEE	D
NOLICHUCKY	B	OCOSTA	C	OOKALA	A	OXFORD	D	PAREHAT	B
NOLIN	B	OCQUEOC	B	OPAL	D	OZAMIS	B/D	PARENT	C
NOLO	B	OCTAGON	B	OPEQUON	C/D	OZAN	D	PARIETTE	C
NOME	C	ODELL	B	OPHIR	C	OZAUKEE	C	PARIS	
NONDALTON	B	ODERMOTT	C	OPIHIKAO	D			PARISHVILLE	C
NONOPAHU	D	ODESSA	D	OQUAGA	C	PAAIKI	B	PARKAY	B
NOOKACHAMPS	C/D	ODIN	C	ORA	C	PAALOA	B	PARKDALE	B
NOOKSACK	B	ODNE	C	ORAN	B	PAAUHAU	A	PARKE	B
NOONAN	D	O'FALLON	D	ORANGE	D	PACHAPPA	B	PARKER	B
NORA	B	OGDEN	D	ORANGEBURG	B	PACHECO	B/C	PARKFIELD	C
NORAD	B	OGEECHEE	C	ORCAS	D	PACK	C	PARKHILL	D
NORBORNE	B	OGEMAW	C	ORCHARD	B	PACKARD	B	PARKHURST	
NORBY	B	OGILVIE	C	ORD	A	PACKER	C	PARKINSON	B
NORD	B	OGLALA	B	ORDNANCE	C	PACKHAM	B	PARKVILLE	C
NORDEN	B	OGLE	B	OROWAY	D	PACKSADDLE	B	PARKWOOD	A/D
NORDNESS	B	OHAYSI	C	ORELIA	D	PACKWOOD	D	PARLEYS	B
NORFOLK	B	OHIA	A	ORELLA	D	PACOLET	B	PARLIN	C
NORGE	B	OJAI	B	OREM	A	PACTOLUS	C	PARLO	B
NORKA	B	OJATA	D	ORESTIMBA	C	PADEN	C	PARMA	C
NORMA	B	OKANOGAN	B	ORFORD	C	PADRONI	B	PARNELL	D
NORREST	C	OKAW	D	ORIDIA	C	PADUCAH	B	PARR	B
NORRIS	C	OKEECHOBEE	A/D	ORIF	A	PADUS	B	PARRAN	D
NORTHDALE	C	OKEELANTA	A/D	ORIO	C	PAESL	B	PARRISH	C
NORTHFIELD	B	OKEMAH	C	ORION	B	PAGET	B	PARSHALL	B
NORTHPORT		OKLARED	B	ORITA	B	PAGODA	C	PARSIPPANY	D
NORTH POWDER	C	OKLAWAHA	A/D	ORLAND	B	PAHRANAGAT	C	PARSONS	D
NORTHUMBERLAND	C/D	OKMOK	C	ORLANDO	A	PAHREAH	D	PARTRI	C
NORTON	C	OKO	D	ORMAN	C	PAHROC	D	PASAGZHAK	B
NORTONVILLE	C	OKOBOJI	C	ORMSBY	B/C	PAIA	C	PASCO	B
NORTUNE	D	OKOLONA	D	ORODELL	C	PAICE	C	PASO SECO	D
NORWALK	B	OKPEEK	D	OROFINO	B	PAINESVILLE		PASQUETTI	C/D
NORWAY FLAT	A	OKTIBBEHA	D	ORO GRANDE	C	PAINTROCK	B	PASQUOTANK	B/D
NORWELL	C	OLA	C	ORONO	D	PAIT	B	PASSAR	C
NORWICH	D	OLAA	A	OROVADA	C	PAJARITO	B	PASS CANYON	D
NORWOOD	B	OLALLA	C	ORR	C	PAJARO	C	PASSCREEK	B
NOTI	D	OLANTA	B	ORRVILLE	C	PAKALA	B	PASTURA	D
NOTUS	A	OLATHE	C	ORSA	A	PAKINI	B	PATAHS	B
NOVARA	B	OLD CAMP	D	ORSINO	A	PALA	B	PATENT	C
NOVARY	B	OLDHAM	C	ORTELLO	A	PALACIO	B	PATILLAS	B
NOWOOD	C	OLDS	C	ORTIGALITA	C	PALAPALAI	B	PATILO	C
NOYE	C	OLDSMAR	B/D	ORTING	C	PALATINE	B	PATIT CREEK	B
NUBY	C	OLDWICK	B	ORTIZ	C	PALESTINE	B	PATNA	C
NUCKOLLS	C	OLELO	B	ORWOOD	B	PALISADE	B	PATOUTVILLE	C
NUCLA	B	OLENA	B	OSAGE	D	PALMA	B	PATRICIA	B
NUECES	C	OLEQUA	B	OSAKIS	B	PALMAREJO	C	PATRICK	B
NUGGET	C	OLETE	B	OSGOOD	B	PALM BEACH	A	PATROLE	C
NUMA	C	OLEX	B	OSHA	B	PALMER	D	PATTANI	D
NUNDA	C	OLGA	C	OSHAWA	D	PALMER CANYON	B	PATTENBURG	B
NUNICA	C	OLI	B	O'SHEA	C	PALMICH	B	PATTERSON	C
NUNN	C	OLIAGA	B	OSHKOSH	C	PALMS	D	PATTON	B/D
NUSS	D	OLINDA	B	OSHTEMO	B	PALMYRA	B	PATWAY	C
NUTLEY	C	OLIPHANT	B	OSIER	B/D	PALO	B	PAUL	B
NUTRAS	C	OLIVEHAIN	C	OSKA	C	PALOMAS	B	PAULDING	D
NUTRIOSO	B	OLIVER	B	OSMUND	B	PALOMINO	D	PAULINA	D
NUVALDE	C	OLIVIER	C	OSO	B	PALOS VERDES	B	PAULSELL	D
NYALA	D	OLMITO	D	OSOBB	D	PALOUSE	B	PAULVILLE	B
NYMORE	A	OLMITZ	B	OSORIDGE	C	PALSGROVE	B	PAUMALU	B
NYSSA	C	OLMOS	C	OSOTE	B	PAMLICO	D	PAUNSAUGUNT	D
NYSSATON	B	OLMSTED	B/D	OSSIAN	C	PAMOA	C	PAUSANT	B
NYSTROM	C	OLNEY	B	OST	B	PAMSDEL	D	PAUWELA	B
		OLOKUI	D	OSTRANDER	B	PANA	B	PAVAHROO	B
OAHE	B	OLPE	C	OTERO	B	PANACA	D	PAVANT	D
OAKDALE	B	OLSON	D	OTHELLO	D	PANAEWA	D	PAVILLION	B
OAKDEN	D	OLTON	C	OTIS	C	PANASOFFKEE	D	PAWCATUCK	D
OAKFORD	B	OLUSTEE	B/D	OTISCO	A	PANCHERI	B	PAWLET	B
OAK GLEN	B	OLYIC	B	OTISVILLE	A	PANCHUELA	C	PAWNEE	D
OAK GROVE	C	OLYMPIC	B	OTLEY	B	PANDO	B	PAXTON	C
OAK LAKE	B	OMAHA	B	OTSEGO	C	PANDLAH	C	PAYETTE	B
OAKLAND	C	OMAK	C	OTTER	B/D	PANDORA	D	PAYMASTER	B
OAKS RIDGE	C	OMEGA	A	OTTERBEIN	C	PANDURA	D	PAYNE	C
OAKVILLE	A	OMENA	B	OTTERHOLT	B	PANE	B	PAYSON	D
OAKWOOD	D	OMNI	C	OTTOKEE	A	PANGUITCH	B	PEACHAM	D
OANAPUKA	B	ONA	A/D	OTWAY	D	PANHILL	B	PEARL HARBOR	D
OASIS	B	ONALASKA	B	OTWELL	C	PANIOGUE	B	PEARMAN	
OATMAN	B	ONAMIA	B	OUACHITA	C	PANKY	C	PEARSOLL	D
OBAN	C	ONARGA	B	OURAY	A	PANOCHE	B	PEAVINE	C
OBARO	B	ONAWA	B	OUTLET	C	PANOLA	D	PECATONICA	B
OBRAY	D	ONAWAY	B	OVALL	C	PANSEY	D	PECOS	D
OBURN	D	ONDAWA	B	OVERGAARD	C	PANTHER	D	PEDEE	C
OCALA	D	ONEIDA	B	OVERLY	C	PANTON	D	PEDERNALES	C
OCEANET	D	O'NEILL	B	OVERTON	D	PAOLA	A	PEDIGO	B/C
OCEANO	A	ONEONTA	B	OVID	C	PAOLI	B	PEDLAR	D
OCHEYEDAN	B	ONITA	C	OVINA	B	PAPAA	D	PEDRICK	B
OCHLOCKONEE	B	ONITE	B	OWEGO	D	PAPAI	A	PEEBLES	C
OCHO	D	ONOTA	C	OWEN CREEK	C	PAPAKATING	D	PEEL	C
OCHOCO	C	ONOVA	C	OWENS	D	PAPOOSE	C	PEELER	B
OCHOPEE	B/D	ONRAY	D	OWHI	B	PARADISE	C	PEEVER	C

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Table B .1--Continued

PEGLER	D	PIE CREEK	D	POE	B/C	PREBLE	C	QUINN	D
PEGRAM	B	PIERIAN	A	POGANEAB	C	PRENTISS	C	QUINNEY	C
PEKIN	C	PIERPONT	C	POGUE	B	PRESQUE ISLE	B	QUINTON	
PELHAM	B/D	PIERRE	D	POHAKUPU	A	PRESTO	A	QUITMAN	C
PELIC	C	PIIHONUA	A	POINSETT	B	PRESTON	A	QUONSET	A
PELLA	D	PIKE	B	POINT	B	PREWITT	C		
PELONA	C	PILCHUCK	A	POINT ISABEL	C	PREY	D	RABER	C
PEMBERTON	A	PILGRIM	B	POJOAQUE	B	PRICE	C	RABEY	A
PEMBINA	C	PILOT	B	POKEGEMA	B	PRIDA	D	RABIDEUX	B
PEMBROKE	B	PILOT ROCK	C	POKER	B	PRIDHAM	D	RABUN	B
PENA	B	PIMA	B	POLAND		PRIETA	C	RACE	D
PENCE	A	PINAL	D	POLAR	B	PRIMEAUX	C	RACHERT	D
PENDEN	B	PINALENO	B	POLATIS	C	PRIMGHAR	B	RACINE	B
PEND OREILLE	B	PINATA	C	POLE	A	PRINCETON	B	RACOON	D
PENDROY	D	PINAVETES	A	POLEBAR	C	PRINEVILLE	C	RAD	C
PENISTAJA	B	PINCHER	C	POLELINE	B	PRING	B	RADFORD	B
PENITENTE	B	PINCKNEY	C	POLEO	C	PRINS	C	RADLEY	C
PENN	C	PINCONNING	D	POLEY	C	PROCTOR	B	RADNOR	D
PENNEL	C	PINCUSHION	B	POLICH	C	PROGRESSO	C	RAFAEL	D
PENNINGTON	B	PINEDA	B/D	POLLARD	C	PROMISE	D	RAGLAN	D
PENNISULA	C	PINEDALE	B	POLLASKY	C	PROMO	D	RAGNAR	B
PENO	C	PINEGUEST	B	POLLY	B	PROMONTORY	B	RAGO	C
PENOYER	C	PINELLOS	A/D	POLO	B	PRONG	C	RAGSDALE	B/D
PENROSE	D	PINETOP	C	POLSON	C	PROSPECT	B	RAGTOWN	D
PENTHOUSE	D	PINEVILLE	B	POLVADERA	C	PROSPER	B	RAHM	C
PENTZ	D	PINEY	C	POMAT	C	PROSSER	C	RAIL	C/D
PENWOOD	A	PINICON	B	POMELLO	C	PROTIVIN	C	RAINBOW	C
PEOGA	C	PINKEL	C	POMPANO	A/D	PROUT	C	RAINEY	B
PEOH	C	PINKSTON	B	POMPONIO	C	PROVIDENCE	C	RAINS	B/D
PEONE	B/C	PINNACLES	C	POMPTON	B	PROVO	C	RAINSBORO	C
PEOTONE	C	PINO	C	POMROY	B	PROVO BAY	D	RAKE	D
PEPOON	B	PINULA	C	PONCENA	D	PROWERS	B	RALSEN	B/C
PEQUEA	C	PINOLE	B	PONCHA	A	PTARMIGAN	B	RAMADA	C
PERCHAS	D	PINON	C	POND	B/C	PUAULU	A	RAMADERO	B
PERCIVAL	C	PINONES	D	POND CREEK	B	PUCHYAN	A	RAMBLER	B
PERELLA	C	PINTAS	D	PONDILLA	A	PUDDLE	D	RAMELLI	C
PERHAM	C	PINTLAR	A	PONIL	D	PUERCO	D	RAMIRES	D
PERICO	B	PINTO	C	PONTOTOC	B	PUETT	D	RAMMEL	C
PERKINS	C	PINTURA	A	PONZER	D	PUGET	C	RAMO	C
PERKS	A	PINTWATER	D	POOKU	A	PUGSLEY	B	RAMONA	B
PERLA	C	PIOPOLIS	D	POOLE	B/D	PUHI	A	RAMPART	B
PERMA	A	PIPER	B/C	POOLER	D	PUHIMAU	D	RAMPARTAR	A
PERMANENTE	C	PIROUETTE	D	POORMA	B	PULASKI	B	RAMSEY	D
PERRIN	B	PISGAH	C	POPE	B	PULEHU	B	RAMSHORN	B
PERRINE	D	PISHKUN	B	POPPLETON	A	PULLMAN	D	RANCE	C
PERROT	D	PISTAKEE	B	POQUONOCK	C	PULS	D	RANCHERIA	B
PERRY	D	PIT	D	PORRETT	B/D	PULSIPHER	D	RAND	B
PERRYVILLE	B	PITTMAN	D	PORT	B	PULTNEY	C	RANDADO	C
PERSAYO	D	PITTSFIELD	B	PORTAGEVILLE	D	PUMPER	C	RANDALL	D
PERSHING	C	PITTSTOWN	C	PORTALES	C	PUNA	A	RANDOLPH	D
PERSIS	B	PITTWOOD	B	PORT BYRON	B	PUNALUU	D	RANDS	C
PERT	D	PLACENTIA	D	PORTERS	B	PUNOHU	A	RANGER	D
PERU	C	PLACERITOS	C	PORTERVILLE	D	PURDAM	C	RANIER	C
PESCADERO	C/D	PLACID	A/D	PORTHILL	C	PURDY	D	RANKIN	C
PESET	C	PLACK	D	PORTINO	C	PURGATORY	D	RANTOUL	D
PESHASTIN	B	PLAINFIELD	A	PORTLAND	D	PURNER	D	RANYHAN	B
PESO	C	PLAINVIEW	C	PORTNEUF	B	PURSLEY	B	RAPELJE	C
PETEETNEET	D	PLAISTED	C	PORTOLA	C	PURVES	D	RAPHO	B
PETERBORO	B	PLANO	B	PORTSMOUTH	D	PUSTOI	A	RAPIDAN	B
PETERS	D	PLATA	B	POSANT	C	PUTNAM	D	RARDEN	C
PETOSKEY		PLATEA	C	POSEY	B	PUUKALA	D	RARICK	B
PETRIE	D	PLATEAU	B	POSITAS	D	PUUONE	C	RARITAN	C
PETROLIA	D	PLATNER	C	POSKIN	C	PUU OO	A	RASBAND	B
PETTONS	C	PLATO	C	POSOS	C	PUU OPAE	B	RASSET	B
PEWAMO	B/D	PLATTE	D	POST	D	PUU PA	B	RATHBUN	C
PEYTON	B	PLATTVILLE	B	POTAMO	D	PUYALLUP	B	RATLIFF	B
PHAGE	B	PLAZA	B/C	POTLATCH	C	PYLE	A	RATON	C
PHARO	B	PLEASANT	C	POTRATZ	C	PYLON	D	RATTLER	B
PHAROLID	D	PLEASANT GROVE	B	POTSDAM	C	PYOTE	A	RAUB	B
PHEBA	C	PLEASANTON	B	POTTER	C	PYRAMID	D	RAUVILLE	D
PHEENEY	B	PLEASANT VALE	B	POTTER	C	PYRMONT	D	RAUZI	B
PHELAN	B	PLEASANT VIEW	B	POTTS	B			RAVALLI	C
PHELPS	B	PLEDGER	D	POUDRE	B	QUAKER	C	RAVENDALE	D
PHIFERSON	B	PLEEK	C	POULTNEY	B	QUAKERTOWN	B	RAVENNA	C
PHILBON	B/D	PLEINE	D	POVERTY	A	QUAMBA	D	RAVOLA	B
PHILLIPS	C	PLEVNA	D	POWDER	B	QUANAH	B	RAWAH	B
PHILLIPSBURG	A	PLOME	C	POWDERHORN	C	QUANDAHL	B	RAWHIDE	D
PHILO	B	PLOVER	B	POWELL	C	QUARLES	D	RAWSON	B
PHILOMATH	D	PLUMAS	B	POWER	B	QUARTZBURG	C	RAY	B
PHIPPS	C	PLUMMER	B/D	POWHITE	C	QUATAMA	C	RAYADO	C
PHOEBE	B	PLUSH	B	POWLEY	D	QUAY	C	RAYENOUF	B
PHOENIX	D	PLUTH	B	POWWATKA	C	QUEBRADA	C	RAYMONDVILLE	D
PIASA	D	PLUTOS	C	POY	D	QUEETS	B	RAYNE	B
PICACHO	C	PLYMOUTH	A	POYGAN	D	QUEMADO	C	RAYNESFORD	B
PICAYUNE	B	POALL	C	POZO	C/D	QUENZER	D	RAYNHAM	C
PICKAWAY	C	POARCH	B	POZO BLANCO	B	QUICKSELL	C	RAYNOR	D
PICKENS	D	POCALLA	A	PRAG	C	QUIGLEY	B	RAZOR	C
PICKETT	B	POCATELLO	B	PRATHER	B	QUILCENE	C	RAZORT	B
PICKFORD	D	POCKER	D	PRATLEY	C	QUILLAYUTE	B	READING	C
PICKWICK	B	POCOMOKE	D	PRATT	A	QUIMBY	C	READINGTON	C
PICO	B	PODO	D	PREACHER	B	QUINCY	A	READLYN	B
PICTOU	B	PODUNK	B	PREBISH	D	QUINLAN	C	REAGAN	B

NOTES A BLANK HYDROLOGIC SOIL GROUP INDICATES THE SOIL GROUP HAS NOT BEEN DETERMINED
TWO SOIL GROUPS SUCH AS B/C INDICATES THE DRAINED/UNDRAINED SITUATION

Table B.1--Continued

REAKOR	B	RHOADES	D	ROCK RIVER	B	RUDYARD	D	SALMON	B
REAL	D	RIB	C	ROCKTON	B	RUELLA	B	SALOL	D
REAP	D	RICCO	D	ROCKWELL	B	RUGGLES	B	SALONIE	B
REARDAN	C	RICETON	B	ROCKWOOD	B	RUIDOSO	C	SALTAIR	D
REAVILLE	C	RICEVILLE	C	ROCKY FORD	B	RUKO	D	SALT CHUCK	A
REBA	C	RICHARDSON	B	RODDY		RULE	B	SALTER	B
REBEL	B	RICHEAU	D	RODMAN	A	RULICK	C	SALTERY	D
REBUCK		RICHEY	C	ROE		RUMBO	C	SALT LAKE	D
RECLUSE	D	RICHFIELD	C	ROEBUCK	D	RUMFORD	B	SALUDA	C
REDBANK	B	RICHFORD	A	ROELLEN	D	RUMNEY	C	SALUVIA	
RED BAY	B	RICHLIE	A	ROESIGER	B	RUMPLE	C	SALVISA	C
RED BLUFF	B	RICHMOND	D	ROHNERVILLE	B	RUM RIVER	C	SALZER	D
RED BUTTE	B	RICHTER	B	ROHRERSVILLE	C	RUNE	C	SAMBA	D
RFDBY	C	RICHVALE	B	ROKEBY	D	RUNNELLS	C	SAMISH	C/D
REDCHIEF	C	RICHVIEW	C	ROLETTE	C	RUNNYMEDE	B	SAMMAMISH	C
REDCLOUD	B	RICHWOOD	B	ROLFE	C	RUPERT	A	SAMPSEL	D
REDDICK	C	RICKMORE	C	ROLISS	D	RUSCO	C	SAMPSON	B
REDDING	D	RICKS	A	ROLLA	C	RUSE	D	SAMSIL	D
REDFIELD	B	RICREST	B	ROLLIN	D	RUSH	C	SAN ANDREAS	C
RED HILL	C	RIDD	C	ROLOFF	C	RUSHTOWN	A	SAN ANTON	B
RED HOOK	C	RIDGEBURY	C	ROMBO	C	RUSHVILLE	D	SAN ANTONIO	C
REDLAKE	D	RIDGECREST	C	ROMEO	C	RUSS	B	SAN ARCACIO	B
REDLANDS	B	RIDGEDALE	B	ROMNEY	C	RUSSELL	B	SAN BENITO	B
REDMANSON	B	RIDGELAND	D	ROMULUS	D	RUSSELLVILLE	C	SANCHEZ	D
REDMOND	C	RIDGELAWN	A	ROND	D	RUSSLER	C	SANDALL	C
REDNUN	C	RIDGELY	B	RONNEBY	B	RUSTON	B	SANDERSON	B
REDOLA	B	RIDGEVILLE	B	RONSON	B	RUTLAND	C	SANCLAKE	D
REDONA	B	RIDGEWAY	D	ROSACHI	C	RUTLEGE	D	SANDLEE	A
REDRIDGE	B	RIETBROCK	C	ROSAMOND	B	RYAN	D	SANELI	D
REDROB	B	RIFFE	B	ROSANE	C	RYAN PARK	B	SAN EMIGDIO	B
RED ROCK	B	RIFLE	A/D	ROSARIO	C	RYDE	B/D	SANGER	B
RED SPUR	B	RIGA	D	ROSCOE	D	RYDER	C	SAN GERMAN	D
REDSTOE	B	RIGGINS	A	ROSCOMMON	D	RYEGATE	B	SANGO	C
REDTHAYNE	B	RILEY	C	ROSEBERRY	B	RYEPATCH	D	SANGREY	A
REDTOM	C	RILLA	B	ROSEBLOOM	D	RYER	C	SANILAC	C
REDVALE	C	RILLITO	B	ROSEBUD	B	RYUS	C	SAN ISABEL	B
REDVIEW	C	RIMER	C	ROSEBURG	B			SAN JOAQUIN	D
REE	B	RIMINI	A	ROSE CREEK	C	SABANA	D	SAN JON	C
REED	C	RIMROCK	D	ROSEGLEN	B	SABANA SECA	D	SAN JOSE	B
REEDER	B	RIN	B	ROSEHILL	D	SABENYO	B	SAN JUAN	A
REEDPOINT	C	RINCON	C	ROSELAND	D	SABINA	C	SAN LUIS	B
REFDY	C	RINCONADA	C	ROSELMS	D	SABINE	A	SAN MATEO	C
REELFOOT	C	RINGLING	C	ROSEMOUNT	B	SABLE	D	SAN MIGUEL	C
REESER	C	RINGO	D	ROSENDALE	B	SAC	B	SANPETE	A
REESVILLE	C	RINGOLD	B	ROSEVILLE	B	SACO	D	SANPITCH	C
REFUGE	C	RINGWOOD	B	ROSEWORTH	C	SACRAMENTO	C/D	SAN POIL	B
REGAN	B	RIO	D	ROSHE SPRINGS	C	SACUL	D	SAN SABA	D
REGENT	C	RIO ARRIBA	D	ROSITAS	A	SADDLE	B	SAN SEBASTIAN	B
REHM	C	RIO GRANDE	B	ROSLYN	B	SADDLEBACK	B	SANTA	C
REICHEL	B	RIO KING	C	ROSMAN	B	SADIE	B	SANTA CLARA	C
REIFF	B	RIO LAJAS	A	ROSNEY	C	SADLER	C	SANTA FE	D
REILLY	A	RIO PIEDRAS	B	ROSS	B	SAFFELL	B	SANTA ISABEL	D
REINACH	B	RIPLEY	B	ROSS FORK	C	SAGANING	D	SANTA LUCIA	C
RELAN	A	RIPON	B	ROSSI	C	SAGE	D	SANTA MARTA	C
RELAY	B	RIRIE	B	ROSSMOYNE	C	SAGEHILL	B	SANTANA	C
RELIANCE	C	RISTA	C	ROSS VALLEY	C	SAGEMOOR	C	SANTAQUIN	A
RELIZ	D	RISUE	D	ROTAN	C	SAGERTON	C	SANTA YNEZ	C
RELSE	B	RITCHEY	B	ROTHIEMAY	B	SAGINAW		SANTEE	D
REMBERT	D	RITNER	C	ROTHSAY	B	SAGO	D	SANTIAGO	B
REMMIT	A	RITTER	B	ROUBIDEAU	C	SAGOUSPE	C	SANTIAM	C
REMSEN	D	RITTMAN	C	ROUEN	C	SAGUACHE	A	SAN TIMOTEO	C
REMUDAR	B	RITZCAC	B	ROUND BUTTE	D	SAHALI	B	SANTONI	D
REMUNDA	C	RITZVILLE	B	ROUNDTOP	D	SAINT ALBANS	B	SANTOS	C
RENFROW	D	RIVERHEAD	B	ROUNDUP	C	SAINT CHARLES	B	SANTO TOMAS	B
RENO	D	RIVERSIDE	A	ROUNDY	C	SAINT CLAIR	D	SAN YSIDRO	D
RENOHILL	C	RIVERTON	B	ROUSSEAU	A	SAINT ELMO	A	SAPP	D
RENOVA	B	RIVERVIEW	B	ROUTON	D	SAINT GEORGE	C	SAPPHIRE	B
RENOX	B	RIVRA	A	ROUTT	C	SAINT HELENS	A	SAPPINGTON	B
RENSHAW	B	RIXIE	C	ROVAL	D	SAINT IGNACE	C	SARA	C
RENSLOW	B	RIZ	D	ROWE	D	SAINT JOE	B	SARALEGUI	B
RENSSELAER	C	RCANCKE	C	ROWENA	D	SAINT JOHNS	B/D	SARANAC	D
RENTIDE	C	ROBBINS	B	ROWLAND	C	SAINT LUCIE	A	SARAPH	D
RENTON	B/C	ROBBS	D	ROWLEY	B	SAINT MARTIN	C	SARATOGA	B
RENTSAC	C	ROBERTS	D	ROXBURY	B	SAINT MARYS	B	SARCO	B
REPARADA	D	ROBERTSDALE	C	ROY	B	SAINT NICHOLAS	D	SARDINIA	C
REPPART	B	ROBERTSVILLE	D	ROYAL	B	SAINT PAUL	B	SARGEANT	D
REPUBLIC	B	ROBIN	B	ROYALTON	C	SAINT THOMAS	D	SARITA	A
RESCUF	C	ROBINSON	D	ROYSTONE	B	SALADO	B	SARKAR	D
RESERVF	B	ROBINSONVILLE	B	ROZA	D	SALAL	B	SARPY	A
RESNER	B	ROBLEDO	D	ROZELLVILLE	B	SALAMATOF	C	SARTELL	A
RET	B/C	ROB ROY	C	ROZETTA	B	SALAS	C	SASKA	B
RETRIEVER	D	ROBY	C	ROZLEE	C	SALCHAKET	B	SASSAFRAS	B
RETSOF	C	ROCHE	C	RUARK	C	SALEM	B	SASSER	B
RETSOK	B	ROCHELLE	C	RUBICON	A	SALEMSBURG	B	SATANKA	C
REXBURG	B	ROCHEPORT	C	RUBIO	C	SALGA	C	SATANTA	B
REXCER	A	ROCKAWAY	C	RUBY	B	SALIDA	A	SATELLITE	C
REYES	C/D	ROCKCASTLE	D	RUCH	B	SALINAS	C	SATT	D
REYNOLDS		ROCK CREEK	D	RUCKLES	D	SALISBURY	D	SATTLEY	B
REYNOSA	B	ROCKFORD	B	RUCLICK	C	SALIX	B	SATTRE	B
REYWAT	D	ROCKINGHAM	C/D	RUDD	D	SALKUM	C	SATUS	B
RHAME	B	ROCKLIN	C	RUDEEN	B	SALLISAW	B	SAUCE	B
RHINEBECK	D	ROCKPORT		RUDOLPH	C	SALLYANN	C	SAUGATUCK	C

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Table B.1--Continued

SAUGUS	B	SELFRIDGE	C	SHIOCTON	B	SKIYOU	B	SPARTA	A
SAUK	B	SELKIRK	D	SHIPLEY	C	SKOKOMISH	B/C	SPEARFISH	B
SAULICH	D	SELLE	B	SHIPROCK	B	SKOOKUMCHUCK	B	SPEARVILLE	C
SAUM	C	SELLERS	A/D	SHIRK	B	SKOWHEGAN	B	SPECK	D
SAUNDERS	C	SELMA	B	SHOALS	C	SKULL CREEK	D	SPECTER	D
SAUVIE	C/D	SEMIAHMOO	D	SHOEFFLER	B	SKUMPAH	D	SPEELYAI	C
SAUVOLA	C	SEMINMOO	D	SHONKIN	D	SKUTUM	C	SPEIGLE	B
SAVAGE	C	SEMINARIO	D	SHOOK	A	SKYBERG	C	SPENARD	C
SAVANNAH	C	SEN	B	SHOREWOOD	C	SKYHAVEN	D	SPENCER	B
SAVO	C	SENECAVILLE	C	SHOREY	B	SKYKOMISH	B	SPERRY	C
SAVOIA	B	SEQUATCHIE	B	SHORN	B	SKYLINE	D	SPICER	C
SAWABE	D	SEQUIM	A	SHORT CREEK	D	SKYWAY	B	SPILLVILLE	B
SAWATCH	C	SEQUOIA	C	SHOSHONE	D	SLAB	C	SPINKS	A
SAWCREEK	B	SERENE	D	SHOTWELL	D	SLATE CREEK	C	SPIRIT	B
SAWMILL	C	SERNA	D	SHOUNS	B	SLAUGHTER	C	SPIRO	B
SAWYER	C	SERODO	A	SHOWALTER	C	SLAVEN	D	SPLENDORA	C
SAXBY	D	SERPA	C/D	SHOWLOW	C	SLAWSON	B	SPLITROCK	D
SAXON	B	SERVOSS	D	SHREWSBURY	D	SLAYTON	D	SPOFFORD	C
SAYBROOK	B	SESAME	C	SHRINE	B	SLEETH	C	SPOKANE	B
SAYLESVILLE	C	SESPE	C	SHROUTS	D	SLETTEN	D	SPONSELLER	B
SAYLOR	A	SESSIONS	C	SHUBUTA	C	SLICKROCK	B	SPOON BUTTE	D
SCALA	B	SESSUM	D	SHULE	B	SLIGHTS	D	SPOONER	C
SCAMMAN	C	SETTERS	C	SHULLSBURG	C	SLIGO	B	SPOTTSWOOD	B
SCANDIA	B	SETTLEMEYER	D	SHUMWAY	D	SLIKOK	C	SPRAGUE	B/C
SCANTIC	C	SEVERN	B	SHUPERT	C	SLIP	B	SPRECKELS	C
SCAR	A	SEVILLE	D	SHUWAH	B	SLOAN	D	SPRING	C/D
SCARBORO	D	SEVY	C	SI	B	SLOCUM	B	SPRING CREEK	C
SCAVE	C	SEWARD	B	SIBLEYVILLE	B	SLODUC	C	SPRINGDALE	B
SCHAFFENAKER	A	SEWELL	B	SIBYLEE	D	SLOSS	C	SPRINGER	B
SCHAMBER	A	SEXTON	D	SICILY	B	SLUICE	B	SPRINGERVILLE	D
SCHAMP	C	SEYMOUR	C	SICKLESTEETS	C	SMARTS	B	SPRINGFIELD	D
SCHAPVILLE	C	SHAAK	D	SIDELL	B	SMITH CREEK	A	SPRINGMEYER	C
SCHEBLY	D	SHADELAND	C	SIFANCIA	B	SMITHNECK	B	SPRINGTOWN	C
SCHERRARD	D	SHAFFER	A	SIEBER	A	SMITHTON	D	SPUR	B
SCHLEY	B	SHAKOPEE	C	SIELO	C	SMOLAN	C	SPURLOCK	B
SCHNORBUSH	C	SHALCAR	D	SIEROCLIFF	D	SMOOT	D	SQUALICUM	B
SCHODACK		SHAM	D	SIERRA	B	SNAG	B	SQUAW	B
SCHODSON	C	SHAMBO	B	SIERRAVILLE	B	SNAHOPISH	B	SQUILLCHUCK	B
SCHOFIELD	B	SHAMEL	B	SIESTA	D	SNAKE	C	SQUIM	B
SCHOHARIE	C	SHANAHAN	B	SIFTON	B	SNAKE HOLLOW	B	SQUIRES	B
SCHOLLE	C	SHANDON		SIGNAL	D	SNAKELUM	B	STAATSBURG	
SCHOOLEY	C/D	SHANE	D	SIGURD	B	SNEAD	D	STABLER	B
SCHRIER	B	SHANO	B	SIKESTON	D	SNELL	C	STACY	B
SCHROOK	B	SHANTA	B	SILCOX	B	SNELLING	B	STADY	B
SCHUMACHER	B	SHAPLEIGH	C/D	SILENT	D	SNOHOMISH	D	STAFFORD	C
SCHUYLKILL	B	SHARATIN	B	SILER	B	SNOQUALMIE	B	STAGECOACH	B
SCIO	B	SHARKEY	D	SILERTON	B	SNOW	B	STAHL	C
SCIOTOVILLE	C	SHARON	B	SILI	D	SNOWDEN	C	STALEY	C
SCISM	B	SHARPSBURG	B	SILVER	D	SNOWLIN	B	STAMBAUGH	B
SCITUATE	C	SHARVANA	C	SILVERBOW	D	SNOWVILLE	D	STAMFORD	D
SCOBEY	C	SHASKIT	B/C	SILVER CREEK	D	SNOWY	A	STAMPEDE	D
SCOOTENEY	B	SHASTA	A	SILVERTON	C	SOAP LAKE	B	STAN	B
SCORUP	C	SHAVANO	B	SILVIES	D	SOBOBA	A	STANDISH	C/D
SCOTT	D	SHAVER	B	SIMAS	C	SOBRANTE	C	STANEY	D
SCOTT LAKE	B	SHAWANO	A	SIMCOE	C	SODA LAKE	B	STANFIELD	C
SCOUT	A	SHAWMUT	B	SIMEON	A	SODHOUSE	D	STANLEY	C
SCOWLALE	C	SHAY	D	SIMMLER	D	SODUS	C	STANSBURY	D
SCRANTON	B/D	SHEAR	C	SIMNER	A	SOELBERG	B	STANTON	D
SCRIBA	C	SHECKLER	C	SIMON	C	SOFIA	C	STAPLETON	B
SCRIVER	B	SHEDD	C	SIMONA	B	SOGN	D	STARBUCK	D
SCROGGIN	C	SHEEGE	D	SIMPERS	B	SOGZIE	B	STARICHKOF	D
SCULLIN	C	SHEEP CREEK	C	SIMPSON	C	SOLANO	D	STARKS	C
SEABROOK	A	SHEEPHEAD	C	SIMS	D	SOLDATNA	B	STARR	B
SEAMAN	C	SHEEPROCK	A	SINAI	C	SOLDIER	D	STASER	B
SEAQUEST	C	SHEETIRON	C	SINCLAIR	B	SOL DUC	B	STATE	B
SEARCHLIGHT	C	SHEFFIELD	D	SINE	C	SOLLEKS	C	STATEN	D
SEARING	B	SHELBURNE	C	SINGLETREE	D	SOLLER	D	STAVE	C
SEARLA	B	SHELBY	B	SINGSAAS	B	SOLOMON	D	STAYTON	D
SEARLES	C	SHELBYVILLE	B	SINNIGAM	C	SOLONA	B	STEAMBOAT	D
SEATON	B	SHELDON		SINUK	B	SOMBRERO	D	STEARNS	D
SEATTLE	D	SHELIKOF	C	SION	B	SOMERS	B	STECUM	A
SEBAGO	D	SHELLABARGER	B	SIOUX	A	SOMERSET	C	STEED	A
SEBASTIAN	D	SHELLDRAKE	A	SIPPLE	A	SOMERVELL	B	STEEDMAN	D
SEBASTOPOL	C	SHELLROCK	A	SISKIYOU	B	SOMSEN	C	STEEKEE	C
SEBEKA	D	SHELMADINE	D	SISSETON	B	SONOITA	B	STEELE	B
SEBEWA	B/D	SHELOCTA	B	SISSON	B	SONOMA	D	STEESE	C
SEBREE	D	SHELTON	C	SITES	C	SONTAG	D	STEFF	C
SEBRING	D	SHENA	C	SITKA	B	SOPER	B	STEGALL	C
SECATA	C	SHENANDOAH	C	SIXMILE	B	SOQUEL	B	STEIGER	A
SECRET	C	SHEPPARD	A	SIZEMORE	B	SORF	C	STEINAUER	B
SECRET CREEK	B	SHERIDAN	B	SIZER	B	SORRENTO	B	STEINBECK	B
SEDAN		SHERM	D	SKAGGS	B	SORTER	B/D	STEINMETZ	D
SEEDSKADEE	D	SHERRYL	B	SKAGIT	B/C	SOSA	C	STEINSBURG	C
SEES	C	SHIBLE	B	SKAHA	A	SOTELLA	C	STEIWER	C
SEEWEE	B	SHIELDS	C	SKALAN	C	SOUTHFORK	D	STELLAR	D
SEGAL	D	SHIFFER	B	SKAMANIA	B	SOUTHGATE	D	STEMILT	C
SEGNO	C	SHILOH	C	SKAMOKAWA	B	SOUTHWICK	C	STENDAL	C
SEHORN	D	SHINAKU	C	SKANEE	C	SPAA	D	STEPHEN	C
SEJITA	D	SHINGLE	D	SKELLOCK	B	SPACE CITY	A	STEPHENSBURG	B
SEKIU	D	SHINGLETOWN	C	SKERRY		SPADE	B	STEPHENVILLE	B
SELAH	C	SHINN	B	SKILLET	C	SPALDING	D	STERLING	A
SELDEN	C	SHINROCK	C	SKINNER	C	SPANAWAY	B	STERLINGTON	B

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Table B .1--Continued

STETSON	B	SUNSET	B	TALLAECCSA	C	TENSAS	D	TIMKEN	D
STETTER	D	SUNSHINE	C	TALLEYVILLE	B	TENSED	C	TIMMERMAN	B
STEUBEN	B	SUNSWEET	C	TALLS	B	TENSLEEP	B	TIMMONS	B
STEVENS	B	SUPAN	B	TALLULA	B	TEOCULLI	B	TIMPAHUTE	D
STEVENSON	B	SUPERIOR	C	TALLY	B	TEPEE	D	TIMPANOGOS	B
STEWART	D	SUPERSTITION	A	TALMAGE	A	TEPETE	B/D	TIMPER	D
STICKNEY	C	SUPERVISOR	C	TALMO	B	TERINO	C	TIMPOONEKE	B
STIDHAM	A	SUPPLEE	B	TALOKA	D	TERMINAL	D	TIMULA	B
STIGLER	C	SUR	B	TALPA	D	TERMO	C	TINA	C
STILLMAN	A	SURGH	B	TAMA	B	TEROUGE	D	TINCAHAY	A
STILLWATER	D	SURPRISE	B	TAMALCO	D	TERRA CEIA	A/D	TINE	A
STILSON	B	SURRENCY	B/D	TAMBA	C/D	TERRAD	D	TINSLEY	A
STIMSON	B/C	SURVYA	C	TAMMANY CREEK	B	TERRERA	C	TINTON	A
STINGAL	B	SUSIE CREEK	D	TAMMS	C	TERRIL	B	TINYTOWN	B
STINSON	C	SUSITNA	B	TAMPICO	B	TERRY	B	TIOCANO	D
STIRK	D	SUSQUEHANNA	D	TANAMA	D	TERWILLIGER	C	TIOGA	B
STIRUM	B	SUTHER	C	TANANA	C	TESAJO	A	TIPPAH	C
STISSING		SUTHERLIN	C	TANBERG	D	TESCOTT	C	TIPPECANOE	B
STIVERSVILLE	B	SUTPHEN	D	TANDY	C	TESUQUE	B	TIPPER	A
STOCKBRIDGE	B	SUTTLER	B	TANEUM	C	TETON	A	TIPPERARY	A
STOCKLAND	B	SUTTON	B	TANEY	C	TETONIA	B	TIPPIPAH	D
STOCKPEN	D	SVEA	B	TANGAIR	C	TETONKA	C	TIPPO	C
STOCKTON	D	SVERDRUP	B	TANNA	C	TETOTUM	C	TIPTON	B
STODICK	D	SVOLD	C	TANNER	C	TEW	B/D	TIPTONVILLE	B
STOKES	D	SWAGER	C	TANSEM	B	TEX	B	TIRA	B
STOMAR	C	SWAKANE	B	TANTALUS	A	TEXLINE	B	TISBURY	B
STONER	B	SWAN	C	TANWAX	D	TEZUMA	C	TISCH	C
STONEWALL	A	SWANBOY	D	TAOPI	C	THACKERY	B	TISH TANG	B
STONO	B/D	SWANNER	D	TAOS	C	THADER	C	TITUSVILLE	C
STONYFORD	D	SWANSON	C	TAPIA	C	THANYON	A	TIVERTON	A
STOOKEY	B	SWANTON	B/D	TAPPEN	D	THATCHER	B	TIVOLI	A
STOPDEN	B	SWANTOWN	C	TARA	B	THATUNA	C	TIVY	C
STORLA	B	SWAPPS	C	TARKIO	D	THAYNE	B	TOA	C
STORM KING	D	SWARTSWOOD	C	TARKLIN	C	THEBES	B	TOBICO	D
STORY	C	SWARTZ	D	TARPO	C	THEBO	D	TOBIN	B
STOSSEL	C	SWASEY	D	TARRANT	C	THEDULUND	C	TOBLER	B
STOUGH	C	SWASTIKA	C	TARYALL	B	THENAS	C	TOBOSA	D
STOWELL	D	SWATARA	A	TASCOSA	B	THERESA	B	TOBY	B
STOY	D	SWAUK	C	TASSEL	D	THERIOT	D	TOCCOA	B
STRAIGHT	C	SWAWILLIA	A	TATE	B	THERMAL	C	TODD	B
STRAIN	B	SWEATMAN	C	TATIYEE	C	THERMOPOLIS	D	TODCLER	B
STRASBURG	C	SWEDE	B	TATU	C	THETFORD	A	TODDVILLE	B
STRATFORD	B	SWEDEN	B	TATUM	C	THIOKOL	C	TOEHEAD	C
STRAUSS	C	SWEEN	C	TAUNTON	C	THOENY	D	TOEJA	C
STRAW	B	SWEENEY	B	TAVARES	A	THOMAS	C	TOEM	C
STRAWN	B	SWEET	C	TAWAS	A/D	THORNDALE	C	TOGO	B
STREATOR	C	SWEETGRASS	B	TAYLOR	C	THORNDIKE	C/D	TOHONA	C
STROLE	B	SWEETWATER	D	TAYLOR CREEK	D	THORNOCK	D	TOINE	C
STRONGHURST	B	SWENODA	B	TAYLORSFLAT	D	THORNTON	C	TOIYABE	C
STRONTIA	B	SWIFTON	A	TAYLORSVILLE	C	THORNWOOD	B	TOKEEN	C
STROUPE	D	SWIMS	A	TAYSOM	B	THOROUGHFARE	B	TOKUL	B
STRYKER	B	SWINGLE	D	TAZLINA	A	THORP	C	TOLBY	B
STUKEL	C	SWISBOB	D	TEAL	D	THORR	B	TOLEDO	D
STUKY	B	SWITCHBACK	C	TEALWHIT	C	THORREL	B	TOLICHA	D
STUMBLE	A	SWITZERLAND	B	TEANAWAY	C	THOW	B	TOLL	A
STUMPP	D	SWOPE	C	TEAPO	B	THREE MILE	C	TOLLGATE	B
STUMP SPRINGS	B	SWYGERT	C	TEAS	C	THUNDERBIRD	C	TOLLHOUSE	D
STUTTGART	D	SYCAMORE	B	TEASDALE	B	THURBER	C	TOLNA	B
STUTZVILLE	B/C	SYCAN	A	TEBO	B	THURLONI	C	TOLO	B
SUBLETTE	B	SYLACAUGA	B/D	TECHICK	B	THURLOW	C	TOLSONA	D
SUDBURY	B	SYLVAN	B	TECOLOTE	B	THURMAN	A	TOLSTOI	D
SUFFIELD	C	SYMERTON	B	TECUMSAH	B	THURMONT	B	TOLT	D
SUGARLOAF	B	SYNAREP	B	TEDROW	B	THURSTON	B	TOLTEC	C
SUISUN	D	SYRACUSE	B	TEEL	B	TIAK	C	TOLUCA	B
SULA	B	SYRENE	D	TEHACHAPI	D	TIBBITTS	B	TOLVAR	B
SULLY	B	SYRETT	C	TEHAMA	C	TICA	C	TOMAH	C
SULPHURA	D			TEJA	D	TICE	C	TOMAS	B
SULTAN	B	TABERNASH	B	TEJON	B	TICHIGAN	C	TOMAST	C
SUMAS	B/C	TABIONA	B	TEKOA	C	TICHNOR	D	TOMERA	D
SUMDUM	D	TABLE MOUNTAIN	B	TELA	B	TICKAPOO	C	TOMICHI	A
SUMMA	B	TABLER	D	TELEFONO	D	TICKASON	B	TOMOKA	A/D
SUMMERFIELD	C	TABOR	C	TELEPHONE	D	TIDWELL	D	TONATA	C
SUMMERS	B	TACOMA	D	TELFER	A	TIERRA	C	TONAWANDA	C
SUMMERVILLE	C	TACUOSH	D	TELL	B	TIETON	B	TONEY	D
SUMMIT	C	TAFT	C	TELLER	B	TIFFANY	C	TONGUE RIVER	B
SUMMITVILLE	B	TAGGERT	C	TELLICO	B	TIFTON	B	TONINI	B
SUMTER	C	TAHOMA	B	TELLMAN	B	TIGER CREEK	B	TONKA	C
SUN	D	TAHQUAMENON	D	TELSTAD	B	TIGERON	A	TONKEY	D
SUNBURST	C	TAHQUATS	C	TEMESCAL	D	TIGIWON	B	TONKS	B
SUNBURY	B	TAINTOR	C	TEMPLE	B/C	TIGRETT		TONOPAH	B
SUNCOOK	A	TAJO	C	TEMVIK	B	TIGUA	D	TONOWEK	B
SUND	C	TAKEUCHI	C	TENABO	D	TIJERAS	B	TONSINA	B
SUNDELL	C	TAKILMA	B	TENAHA	B	TILFORD	B	TONUCO	B
SUNDERLAND	C/D	TAKOTNA	B	TENAS	C	TILLEDA	B	TOOLE	D
SUNDOWN	B	TALANTE	C	TENCEE	C	TILLICUM	B	TOOMES	D
SUNFIELD	B	TALAPUS	B	TENCRIFFE	C	TILLMAN	C	TOP	C
SUNNILAND	C	TALBOTT	C	TENEX	A	TILMA	C	TOPPENISH	B/C
SUNNYHAY	D	TALCOT	C	TENIBAC	B	TILSIT	C	TOPTON	
SUNNYSIDE	B	TALIHINA	D	TENINO	B	TILTON	B	TOQUERVILLE	D
SUNNYVALE	C	TALKEETNA	C	TENNO	D	TIMBERG	C	TOQUOP	A
SUNRAY	C	TALLAC	B	TENOT	C	TIMBERLY	D	TORBOY	B
SUNRISE	C	TALLADEGA	C	TENREG	B	TIMENTWA	B	TORCHLIGHT	C

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Table B.1--Continued

TORHUNTA	C	TRUCKEE	C	UKIAH	C	VASHTI	C	VOLINIA	B
TORNING	B	TRUCKTON	B	ULEN	B	VASQUEZ	B	VOLKE	C
TOROOA	B	TRUESDALE	C	ULLOA	B	VASSAR	B	VOLKMAR	B
TORONTO	C	TRULL	C	ULM	B	VASTINE	C	VOLNEY	B
TORPEDO LAKE	C	TRULON	B	ULRICHER	B	VAUCLUSE	C	VOLPERIE	C
TORREON	C	TRUMAN	B	ULUPALAKUA	B	VAUGHNSVILLE	C	VOLTAIRE	D
TORRES	B	TRUMBULL	D	ULYSSES	B	VAYAS	O	VOLUSIA	C
TORRINGTON	B	TRUMR	D	UMA	A	VEAL	B	VONA	B
TORRO	C	TRYON	D	UMAPINE	B/C	VEAZIE	B	VORE	B
TORTUGAS	D	TSCHICOMA	C	UMIKOA	B	VEBAR	B	VROOMAN	B
TOTEM	B	TUB	C	UMIL	D	VEBAR	B	VULCAN	C
TOTTEN	B	TUBAC	C	UMNAK	B	VEGA	C	VYLACH	O
TOUCHET	B	TUCANNON	C	UMPA	B	VEGA ALTA	C		
TOUHEY	B	TUCKERMAN	D	UNA	D	VEGA BAJA	C	WABANICA	D
TOULON	B	TUCUMCARI	C	UNADILLA	B	VEKOL	D	WABASH	O
TOURN	C	TUFFIT	O	UNAWEEP	B	VELMA	B	WABASHA	D
TOURNQUIST	B	TUGHILL	D	UNCOMPAGHRE	C	VELVA	B	WABASSA	B/D
TOURS	B	TUJUNGA	A	UNEEDA	B	VENA	B	WABEK	B
TOUTLE	A	TUKEY	C	UNGERS	B	VENANGO	C	WACA	C
TOWER	D	TUKWILA	D	UNION	C	VENATOR	D	WACOTA	B
TOWNER	B	TULA	C	UNIONTOWN	B	VENETA	C	WACCUSTA	C
TOWNLEY	C	TULANA	C/D	UNIONVILLE	C	VENEZIA	D	WADAMS	B
TOWNSBURY	B	TULARE	C/D	UNISON	C	VENICE	D	WADDELL	B
TOWNSEND	C	TULAROSA	C	UPSAL	C	VENLO	D	WADDOUPS	B
TOWSON	B	TULIA	B	UPSHUR	C	VENUS	B	WADENA	B
TOXAWAY	D	TULLER	D	UPTON	C	VERBOORT	D	WADESBORO	B
TOY	D	TULLOCK	B	URACCA	B	VERDE	C	WADLEIGH	C
TOYAH	B	TULLY	C	URBANA	C	VERDEL	D	WADMALAW	O
TOZE	B	TUMBEZ	D	URBO	O	V-RDELLA	D	WADSWORTH	C
TRABUCO	C	TUMEY	D	URICH	D	VERDIGRIS	B	WAGES	B
TRACK	B	TUMITAS	B	URNE	B	VEROUN	O	WAGNER	D
TRACY	B	TUMWATER	A	URSINE	C	VERGENNES	C	WAGRAM	A
TRAER	C	TUNEHEAN	D	URTAH	C	VERHALEN	C	WAHA	C
TRAIL	A	TUNICA	D	URWIL	D	VERMEJO	D	WAHEE	D
TRAIL CREEK	B	TUNIS	D	USAL	B	VERNAL	B	WAHIAWA	B
TRANSYLVANIA	B	TUNKHANNOCK	A	USPAR	B	VERNALIS	B	WAHIKULI	B
TRARPER	A	TUNNEL	B	USINE	B	VERNON	D	WAHKEENA	B
TRAPRIST	C	TURELO	C	USKA	O	VERONA	C	WAHKIACUS	B
TRASK	C	TUPUKNUK	D	UTALINE	B	VESSER	C	WAHLUKE	B
TRAVER	B/C	TURBEVILLE	C	UTE	C	VESTON	C	WAHPETON	C
TRAVESSILLA	D	TURBOTVILLE	C	UTICA	A	VETAL	A	WAHTIGUP	B
TRAVIS	C	TURBYFILL	B	UTLEY	B	VETERAN	B	WAHTUM	B/C
TRAWICK	B	TURIN	B	UTUADO	B	VEYO	D	WAIAHA	C
TRAY	C	TURK	D	UVADA	D	VIA	B	WAIAKOA	C
TREADWAY	D	TURKEYSPRINGS	C	UVALDE	C	VIAN	B	WAIALEALE	D
TREASURE	B	TURLEY	C	UWALA	B	VIBORAS	D	WAIALUA	B
TREBLOC	D	TURLIN	B			VIBORG	B	WAIAWA	O
TREGO	C	TURNBOW	C	VACHERIE	C	VICKERY	C	WAIHUNA	D
TRELONA	D	TURNER	B	VADER	B	VICKSBURG	B	WAIKALOA	B
TREMBLES	B	TURNERVILLE	B	VADO	A	VICTOR	A	WAIKANE	B
TREMRE	A	TURNEY	B	VAIDEN	O	VICTORIA	C	WAIKAPU	B
TREMPEALEAU	B	TURRET	B	VAILTON	B	VICTORY	B	WAIKOMO	D
TRENARY	B	TURRIA	C	VALCO	C	VICU	C	WAILUKU	B
TRENT	B	TUSCAN	D	VALDEZ	B/C	VIUA	B	WAIMEA	B
TRENTON	D	TUSCARAWAS	C	VALE	B	VIDRINE	C	WAINEE	B
TREP	B	TUSCARORA	C	VALENCIA	B	VIENNA	B	WAINOLA	A
TRES HERMANOS	C	TUSCOLA	B	VALENT	A	VIEQUES	B	WAIPAHU	C
TRES HERMANOS	C	TUSCUMBIA	C	VALENTINE	A	VIEW	C	WAISKA	B
TRETTEN	C	TUSEL	C	VALFRA	C	VIGAR	C	WAITS	B
TREVINO	D	TUSKEEGO	C	VALKARIA	B/D	VIGO	O	WAKE	D
TREXLER	C	TUSLER	B	VALLAN	D	VIKING	D	WAKEEN	B
TRIAMI	C	TUSQUITEE	B	VALLECITOS	C	VIL	C	WAKEFIELD	B
TRIASSIC		TUSTIN	B	VALLERS	C	VILAS	A	WAKELAND	B/D
TRICON	C	TUSTUMENA	B	VALMONT	C	VILLA GROVE	B	WAKONDA	C
TRIDELL	B	TUTHILL	B	VALMY	B	VILLARS	B	WALCOTT	B
TRIDENT	D	TUTTLE	B	VALOIS	B	VINA	B	WALDECK	C
TRIGO	C	TUTWILER	B	VANAJO	O	VINCENNES	C	WALDO	D
TRIMBLE	B	TUXEDO		VANANDA	D	VINCENT	C	WALDRON	D
TRIMMER	B	TUXEKAN	B	VAN BUREN		VINEYARD	C	WALDROUP	O
TRINCHERA	C	TWILACKS	A	VANCE	C	VINGO	B	WALES	C
TRINITY	D	TWIN CREEK	B	VANDA	D	VINING	C	WALFORD	C
TRIPLEN	C	TWINING	C	VANDALIA	C	VINITA	C	WALKE	C
TRIROLI	C	TWISP	B	VANDERDASSON	O	VINLAND	C	WALL	B
TRIPR	B	TWO DOT	C	VANDERGRIFT	C	VINTON	B	WALLACE	B
TRITON	C	TYEE	O	VANDERHOFF	D	VIRA	C	WALLA WALLA	B
TRIX	B	TYGART	D	VANDERLIR	A	VIRATON	C	WALLER	B/D
TROJAN	B	TYLER	D	VAN DUSEN	B	VIRDEN	C	WALLINGTON	C
TROMMALD	D	TYNDALL	B/C	VANET	C	VIRGIL	B	WALLIS	B
TROMP	B/C	TYNER	A	VANG	B	VIRGIN REAK	D	WALLKILL	C/C
TRONSEN	B	TYRONE	C	VANHORN	B	VIRGIN RIVER	D	WALLMAN	C
TROOK	B	TYSON	C	VAN NOSTERN	B	VIRTUE	B	WALLOWA	C
TROPAL	D			VANNOY	B	VISALIA	B	WALLPACK	
TROSI	D	UBAR	C	VANOSS	B	VISTA	C	WALLROCK	B
TROUR	A	UBLY	B	VANTAGE	C	VIVES	B	WALLSBURG	D
TROUT CREEK	C	UCOLA	C	VAN WAGONER	D	VIVI	B	WALLSON	B
TROUTDALE	B	UCORIA	B	VARCO	C	VLASATY	C	WALPOLE	C
TROUT LAKE	C	UDEL	D	VARELUM	C	VOCA	C	WALSH	B
TROUT RIVER	A	UDOLPHO	C	VARICK	D	VODERMAIER	B	WALSHVILLE	D
TROUTVILLE	B	UFFENS	D	VARINA	C	VOLADORA	B	WALTERS	A
TROXEL	B	UGAK	D	VARNA	C	VOLENTE	C	WALTON	C
TROY	C	UHLIG	B	VARRO	B	VOLGA	D	WALUM	B
TRUCE	C	UINTA	B	VARYSBURG	B	VOLIN	B	WALVAN	B

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Table B.1--Continued

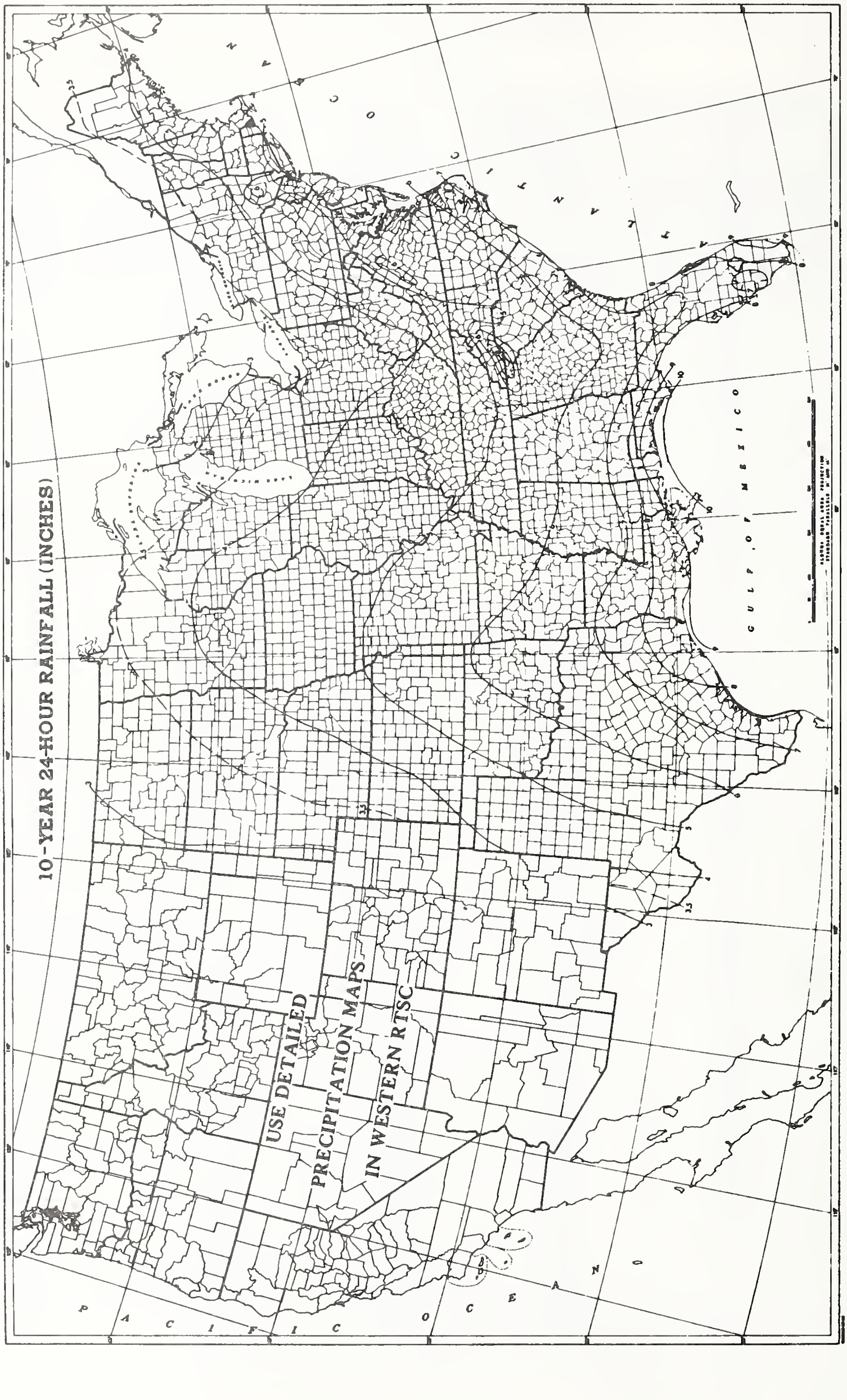
WAMBA	B/C	WEHADKEE	D	WHITNEY	B	WINU	C	YAMPA	C
WAMIC	B	WEIKERT	C/D	WHITORE	A	WINZ	C	YAMSAY	D
WAMPSVILLE	B	WEIMER	D	WHITSOL	B	WIOTA	B	YANA	B
WANATAH	B	WEINBACH	C	WHITSON	D	WISHEYLU	C	YAQUINA	B/D
WANBLEE	D	WEIR	D	WHITWELL	C	WISKAH	C	YARDLEY	C
WANDO	A	WEIRMAN	B	WHOLAN	C	WISNER	D	YATES	D
WANETTA	A	WEISER	C	WIBAUX	D	WITBECK	D	YAWDIM	D
WANN	A	WEISHAUPT	C	WICHITA	C	WITCH	D	YAWKEY	C
WANK	A	WEISS	A	WICHUP	D	WITHAM	D	YAXON	B
WAPAL	B	WEITCHPEC	B	WICKERSHAM	B	WITHEE	C	YEATES HOLLOW	C
WAPATO	C/D	WELBY	B	WICKETT	C	WITT	C	YEGEN	B
WAPELLO	B	WELCH	C	WICKHAM	B	WITZEL	D	YELM	B
WAPINITIA	B	WELD	C	WICKIUP	C	WODEN	B	YENRAB	A
WAPPING	B	WELDA	C	WICKLIFFE		WODSKOW	B	YEOMAN	B
WAPSIE	B	WELDON	C	WICKSBURG	B	WOLCOTTSBURG		YETULL	A
WARBA	B	WELDONA	B	WIDTSOE	C	WOLDALE	C/D	YODER	B
WARD	D	WELLER	C	WIEHL	C	WOLF	B	YOKOHL	D
WARDBORO	A	WELLERHORN	C	WIEN	D	WOLFESEN	C	YOLLABOLLY	D
WARDELL	D	WELLINGTON	D	WIGGLETON	B	WOLFORD	B	YOLO	B
WARDEN	B	WELLMAN	B	WILBRAHAM	C	WOLF POINT	D	YOLOGO	D
WARDWELL	C	WELLNER	B	WILBUR	C	WOLFTEVER	C	YOMONT	B
WARE	B	WELLSBORO	C	WILCO	C	WOLVERINE	A	YONCALLA	C
WAREHAM	C	WELLSTON	B	WILCOX	D	WOODBINE	B	YONGES	D
WARMAN	D	WELLSVILLE	B	WILCOXSON	D	WOODBRIDGE	C	YONNA	B/D
WARM SPRINGS	C	WEMPLE	B	WILDCAT	D	WOODBURN	C	YORDY	B
WARNERS	A/D	WENAS	B/C	WILDER	B	WOODBURY	D	YORK	C
WARREN		WENATCHEE	C	WILDERNESS	C	WOODCOCK	B	YORKVILLE	D
WARRENTON	B/D	WENDEL	B/C	WILDROSE	D	WOODENVILLE	C	YOST	C
WARRIOR		WENHAM		WILDWOOD	D	WOOGLEN	D	YOUGA	B
WARSAW	B	WENONA	C	WILEY	C	WOODHURST	A	YOUMAN	C
WARSING	B	WENTWORTH	B	WILKES	C	WOODLY	B	YOUNGSTON	B
WARWICK	A	WERNER	B	WILKESON	C	WOODLYN	C	YOURAME	A
WASATCH	A	WESO	C	WILKINS	D	WOODMANSIE	B	YOVIMPA	D
WASEPI	B	WESSEL	B	WILL	D	WOODMERE	B	YSIDORA	C
WASHBURN		WESTBROOK	D	WILLACY	B	WOOD RIVER	D	YTURBIDE	A
WASHINGTON	B	WESTBURY	C	WILLAKENZIE	C	WOODROCK	B	YUBA	D
WASHOE	C	WESTCREEK	B	WILLAMAR	D	WOODROW	C	YUKON	D
WASHOUGAL	B	WESTERVILLE	C	WILLAMETTE	B	WOODS CROSS	D	YUNES	D
WASHTENAW	C/D	WESTFALL	C	WILLAPA	C	WOODSFIELD	C	YUNQUE	C
WASILLA	C	WESTFIELD		WILLARD	C	WOODSIDE	A		
WASIOJA	C	WESTFORD		WILLETTE	A/D	WOODSON	D	ZAAR	D
WASSAIC	B	WESTLAND	B/D	WILLHAND	B	WOODSTOCK	C/D	ZACA	C
WATAB	C	WESTMINSTER	C/D	WILLIAMS	B	WOODSTOWN	C	ZACHARIAS	B
WATAUGA	B	WESTMORE	B	WILLIAMSBURG	B	WOODWARD	B	ZACHARY	D
WATCHAUG	B	WESTMORELAND	B	WILLIAMSON	C	WOOLMAN	B	ZAFRA	B
WATCHUNG	D	WESTON	D	WILLIS	C	WOOLPER	C	ZAHILL	B
WATERBORO		WESTPHALIA	B	WILLITS	B	WOOLSEY	C	ZAHL	B
WATERBURY	D	WESTPLAIN	C	WILLOUGHBY	B	WOOSLEY	B	ZALESKI	C
WATERIND	C	WESTPORT	A	WILLOW CREEK	B	WOOSTER	C	ZALLA	A
WATERS	C	WESTVILLE	B	WILLOWDALE	B	WOOSTERN	B	ZAMORA	B
WATKINS	B	WETHERSFIELD	C	WILLOWS	D	WOOTEN	A	ZANE	C
WATKINS RIDGE	B	WETHEY	B/C	WILLWOOD	A	WORCESTER	B	ZANEIS	B
WATOPA	B	WETZEL	D	WILMER	C	WORF	D	ZANESVILLE	C
WATROUS	B	WEYMOUTH	B	WILPAR	D	WORK	C	ZANONE	C
WATSEKA	C	WHALAN	B	WILSON	D	WORLAND	B	ZAPATA	C
WATSON	C	WHARTON	C	WILTSHIRE	C	WORLEY	C	ZAVALA	B
WATSONIA	D	WHATCOM	C	WINANS	B/C	WORMSER	C	ZAVCO	C
WATSONVILLE	D	WHATELY	D	WINCHESTER	A	WOROCK	B	ZEB	B
WATT	D	WHEATLEY	D	WINCHUCK	C	WORSHAM	D	ZEESIX	C
WATTON	C	WHEATRIDGE	C	WINDER	B/D	WORTH	C	ZELL	B
WAUBAY	B	WHEATVILLE	B	WINDMILL	B	WORTHEN	B	ZEN	C
WAUBEEK	B	WHEELER	B	WINDOM	B	WORTHING	D	ZENDA	C
WAUBONSIE	B	WHEELING	B	WIND RIVER	B	WORTHINGTON	C	ZENIA	B
WAUCHULA	B/D	WHEELOCK	C	WINDSOR	A	WORTMAN	C	ZENIFF	B
WAUCOMA	B	WHEELON	D	WINDTHORST	C	WRENTHAM	C	ZEONA	A
WAUCONDA	B	WHELCHEL	B	WINDY	C	WRIGHT	C	ZIEGLER	C
WAUKEE	B	WHETSTONE	B	WINEG	B	WRIGHTSVILLE	D	ZIGWEID	B
WAUKEGAN	B	WHIDBEY	B	WINEMA	C	WUNJEY	B	ZILLAH	B/C
WAUKENA	D	WHIPPANY	C	WINETTI	B	WURTSBORO	C	ZIM	D
WAUKON	B	WHIPSTOCK	C	WINFIELD	C	WYALUSING	D	ZIMMERMAN	A
WAUMBEK	B	WHIRLO	C	WING	D	WYARD	B	ZING	C
WAUPIKA	D	WHIT	B	WINGATE	B	WYARNO	C	ZINZER	B
WAUSEON	B/D	WHITAKER	C	WINGER	C	WYATT	C	ZION	C
WAVERLY	B/D	WHITCOMB	C	WINGVILLE	B/D	WYEAST	C	ZIPP	C/D
WAWAKA	C	WHITE BIRD	C	WINIFRED	C	WYEVILLE	C	ZITA	B
WAYCUP	B	WHITECAP	D	WINK	B	WYGANT	B	ZOAR	C
WAYDEN	D	WHITEFISH	B	WINKLEMAN	C	WYKOFF	B	ZOHNER	B/D
WAYLAND	C/D	WHITEFORD	B	WINLO	D	WYMAN	B	ZOOK	C
WAYNE	B	WHITEHORSE	B	WINLOCK	C	WYMORE	C	ZORRAVISTA	A
WAYNESBORO	B	WHITE HOUSE	C	WINN	C	WYNN	B	ZUFELT	B
WAYSIDE		WHITELAKE	B	WINNEBAGO	B	WYNOOSE	D	ZUMBRO	B
WEA	B	WHITELAW	B	WINNEMUCCA	B	WYO	B	ZUMWALT	C
WEAVER	C	WHITEMAN	D	WINNESHIEK	B	WYOCENA	B	ZUNDELL	B
WEBB	C	WHITEROCK	D	WINNETT	D			ZUNHALL	B
WEBER	B	WHITESBURG	C	WINONA	D	YACOLT	B	ZUNI	C
WEBSTER	C	WHITE STORE	D	WINOOSKI	B	YAHARA	B	ZURICH	B
WEDGE	A	WHITE SWAN	C	WINSTON	A	YAHOLA	B		
WEDOWEE	B	WHITEWATER	B	WINTERS	C	YAKIMA	B		
WEED	C	WHITEWOOD	C	WINTERSBURG	B	YAKUS	D		
WEEDING	A	WHITLEY	B	WINTERSET	C	YALLANI	B		
WEEDMARK	B	WHITLOCK	B	WINTHROP	A	YALMER	B		
WEEKSVILLE	B/D	WHITMAN	D	WINTONER	C	YAMHILL	C		

NOTES A BLANK HYDROLOGIC SOIL GROUP INDICATES THE SOIL GROUP HAS NOT BEEN DETERMINED
TWO SOIL GROUPS SUCH AS B/C INDICATES THE DRAINED/UNDRAINED SITUATION

APPENDIX C

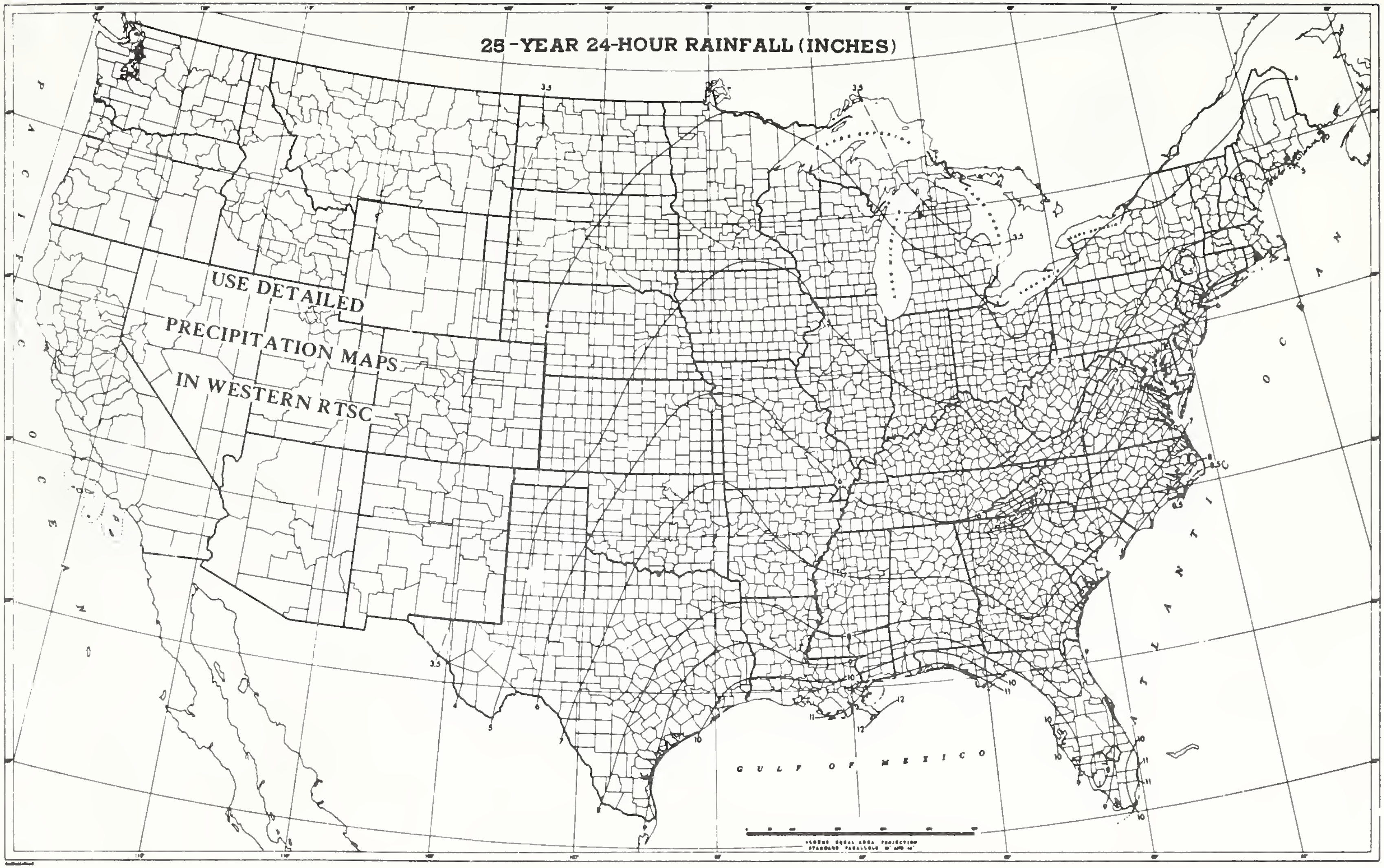
RAINFALL MAPS OF CONTERMINOUS UNITED STATES FOR 24-HOUR RAINFALL AMOUNTS

This appendix contains maps of the conterminous United States showing 24-hour rainfall amounts up to 100-year frequency for areas east of 105° longitude. For areas west of 105° longitude, use the detailed precipitation maps provided for each state. These may be obtained from the West Technical Service Center, SCS, Portland, Oreg.



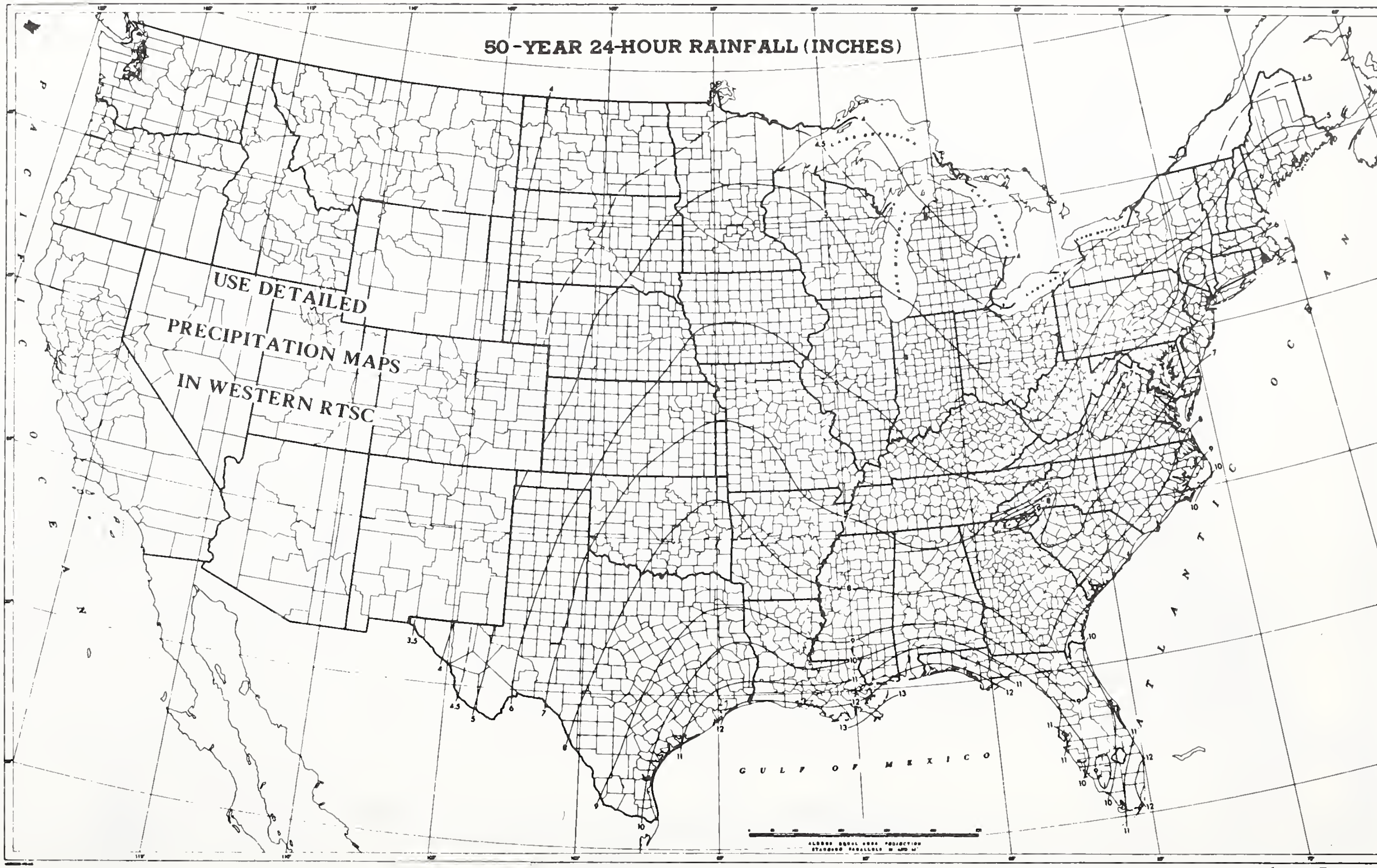
Prepared by U. S. Weather Bureau

CONTERMINOUS UNITED STATES



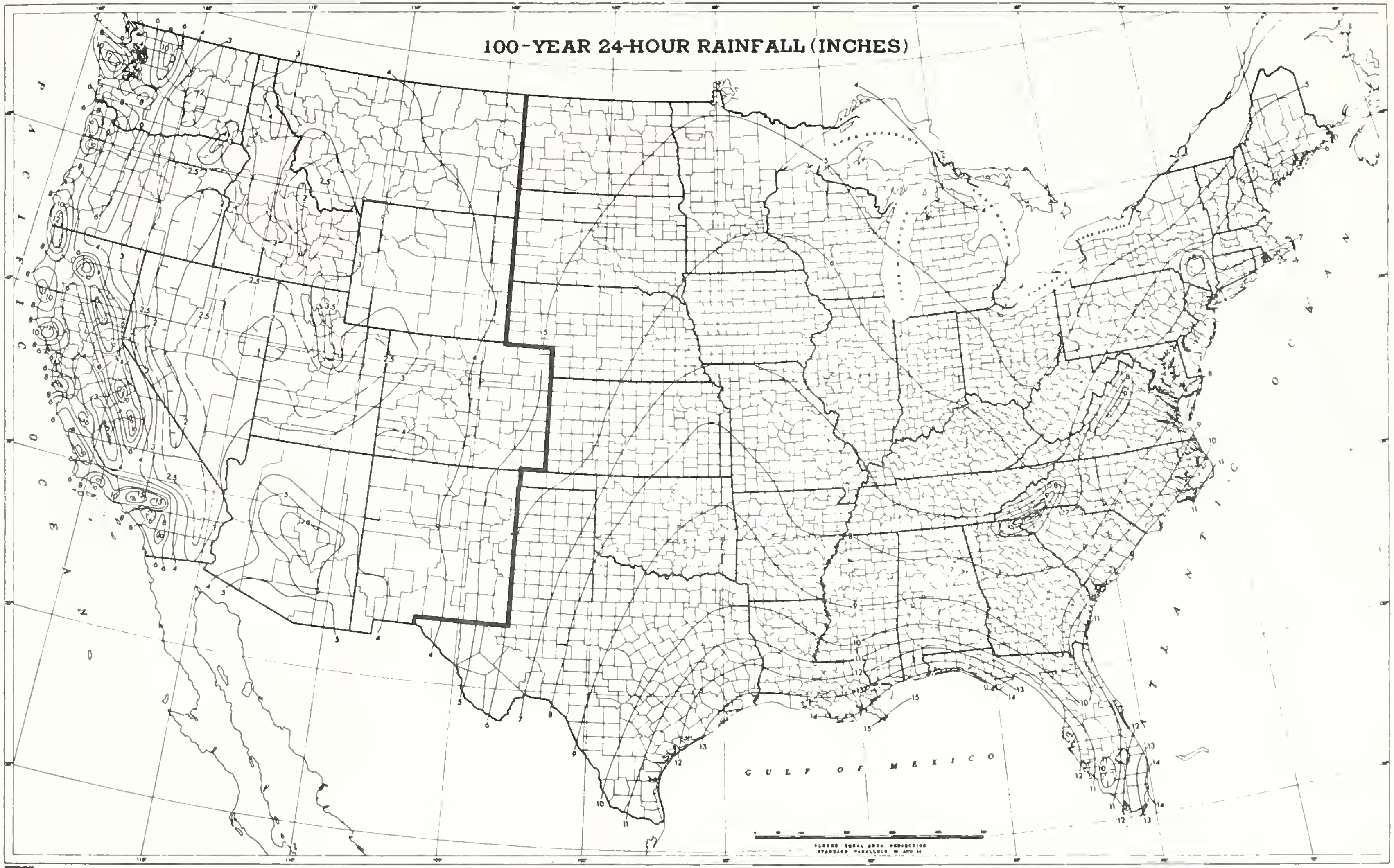
Prepared by U. S. Weather Bureau

CONTERMINOUS UNITED STATES



Prepared by U. S. Weather Bureau

CONTERMINOUS UNITED STATES



Prepared by U. S. Weather Bureau

APPENDIX D

PEAK RATES OF DISCHARGE FOR SMALL WATERSHEDS

This appendix contains charts for estimating peak rates of runoff from small watersheds for use with procedures in chapter 4 of this technical release. They provide a basic peak discharge rate for a 24-hour duration storm associated with a watershed in a natural condition. To use these charts to determine peak rates of runoff in urban areas, the peaks must be modified for the amount of urbanization according to factors discussed in chapter 4 and for other factors discussed in appendix E.

Figure D-1 shows the storm distribution regions for the Pacific Coast states. For all other states SCS uses only type-II storm distribution.

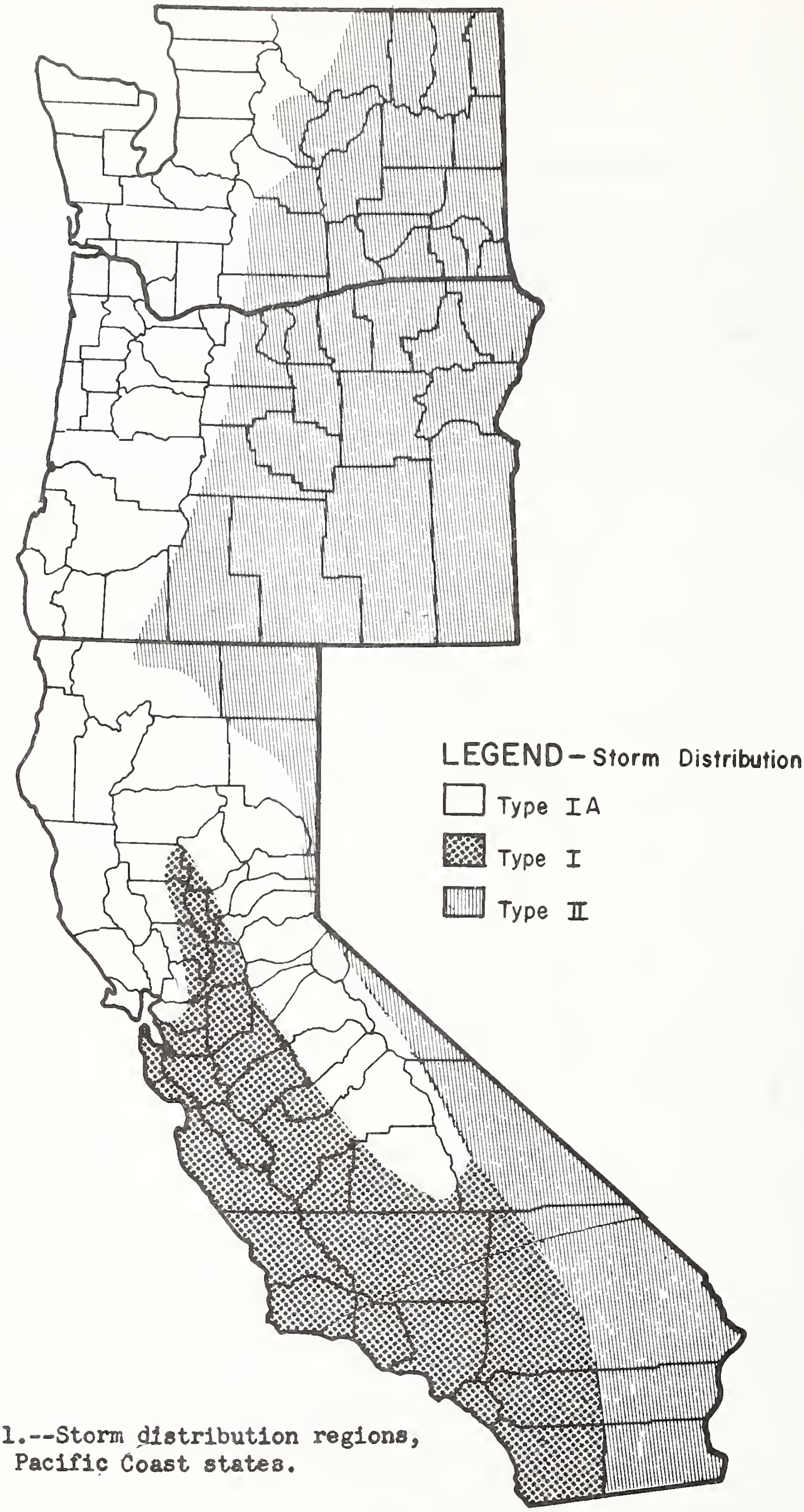


Figure D-1.--Storm distribution regions, Pacific Coast states.

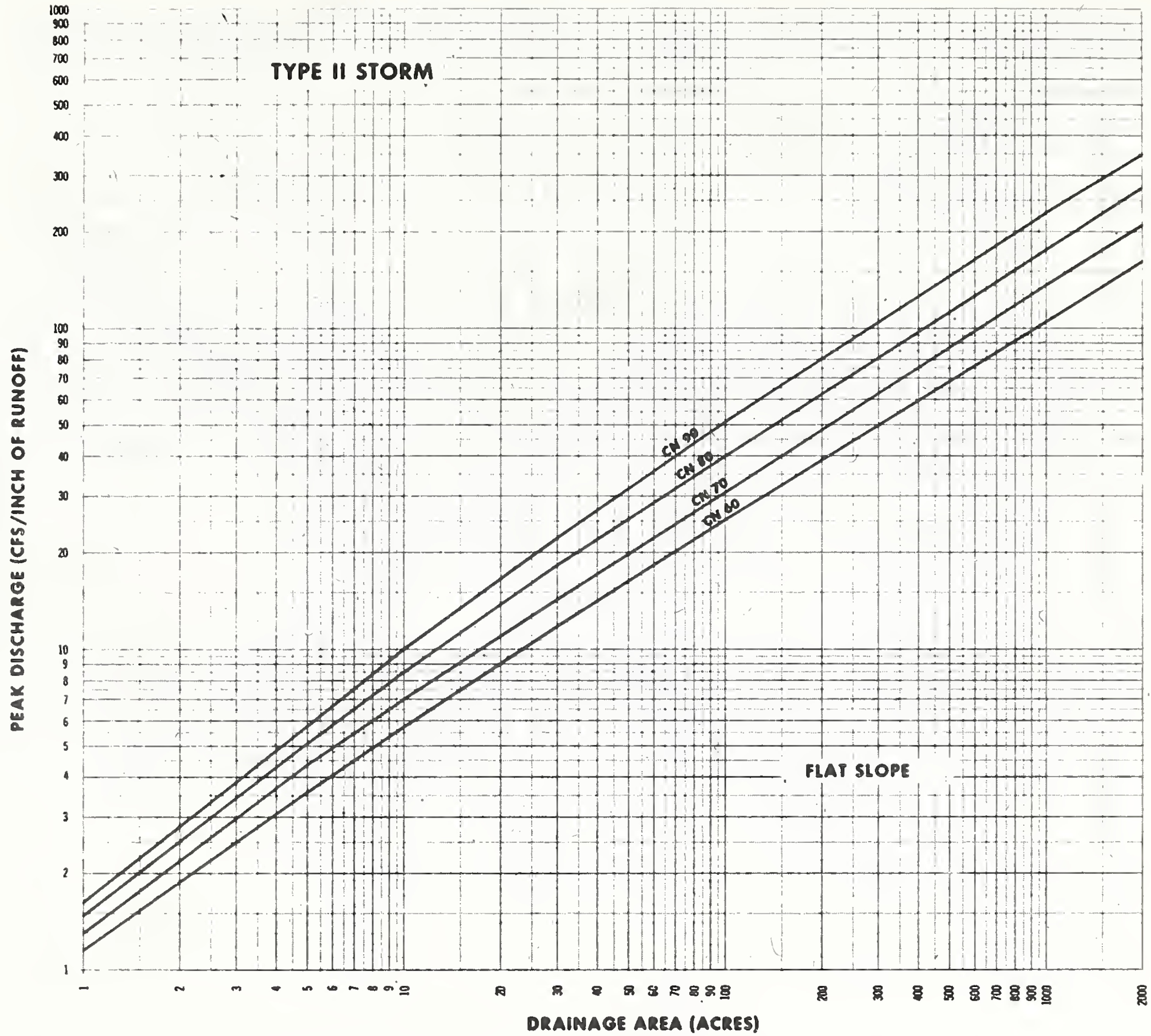


Figure D-2.--Peak rates of discharge for small watersheds (24-hour, type-II storm distribution). Sheet 1 of 3

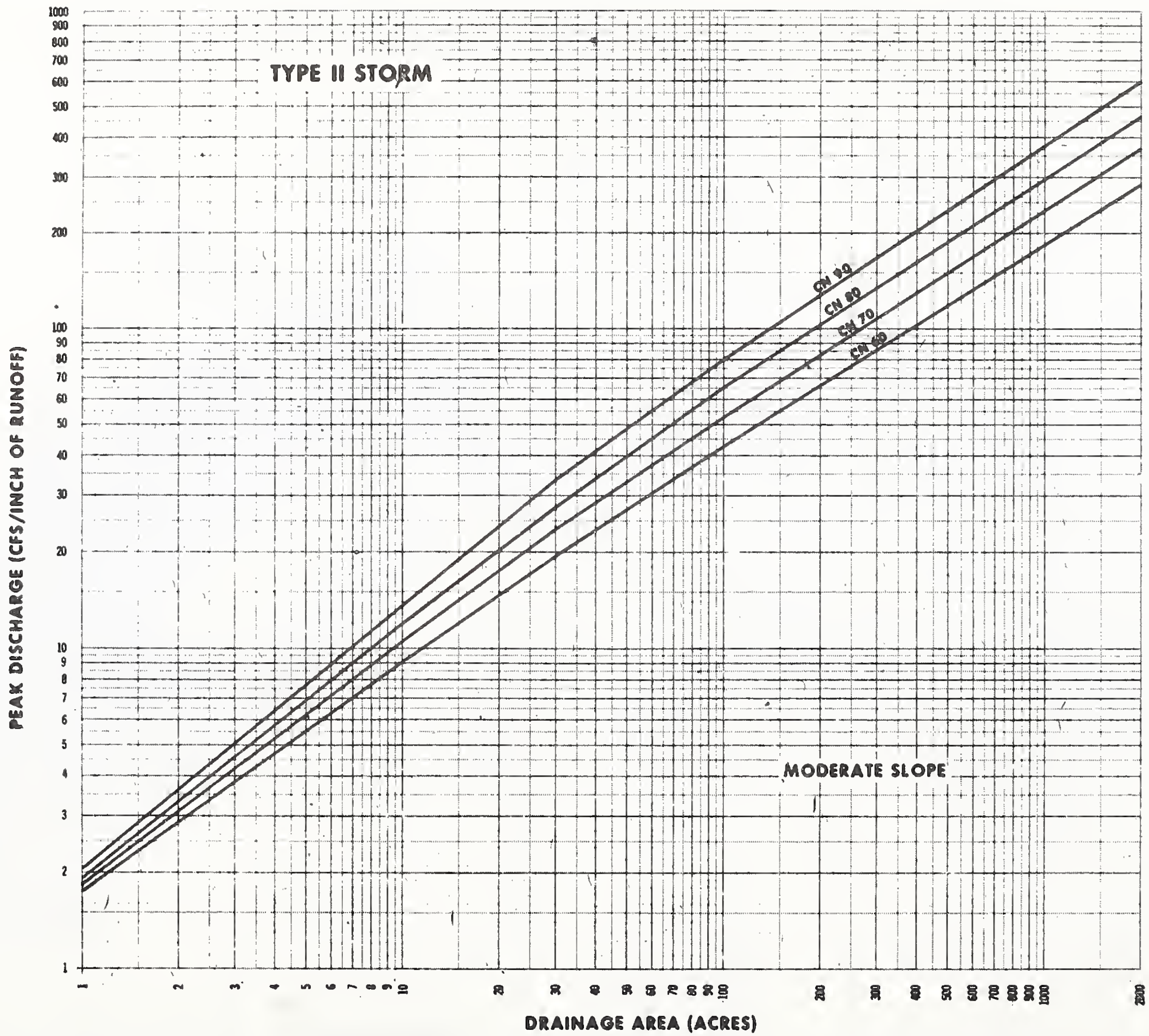


Figure D-2.--Peak rates of discharge for small watersheds (24-hour, type-II storm distribution). Sheet 2 of 3

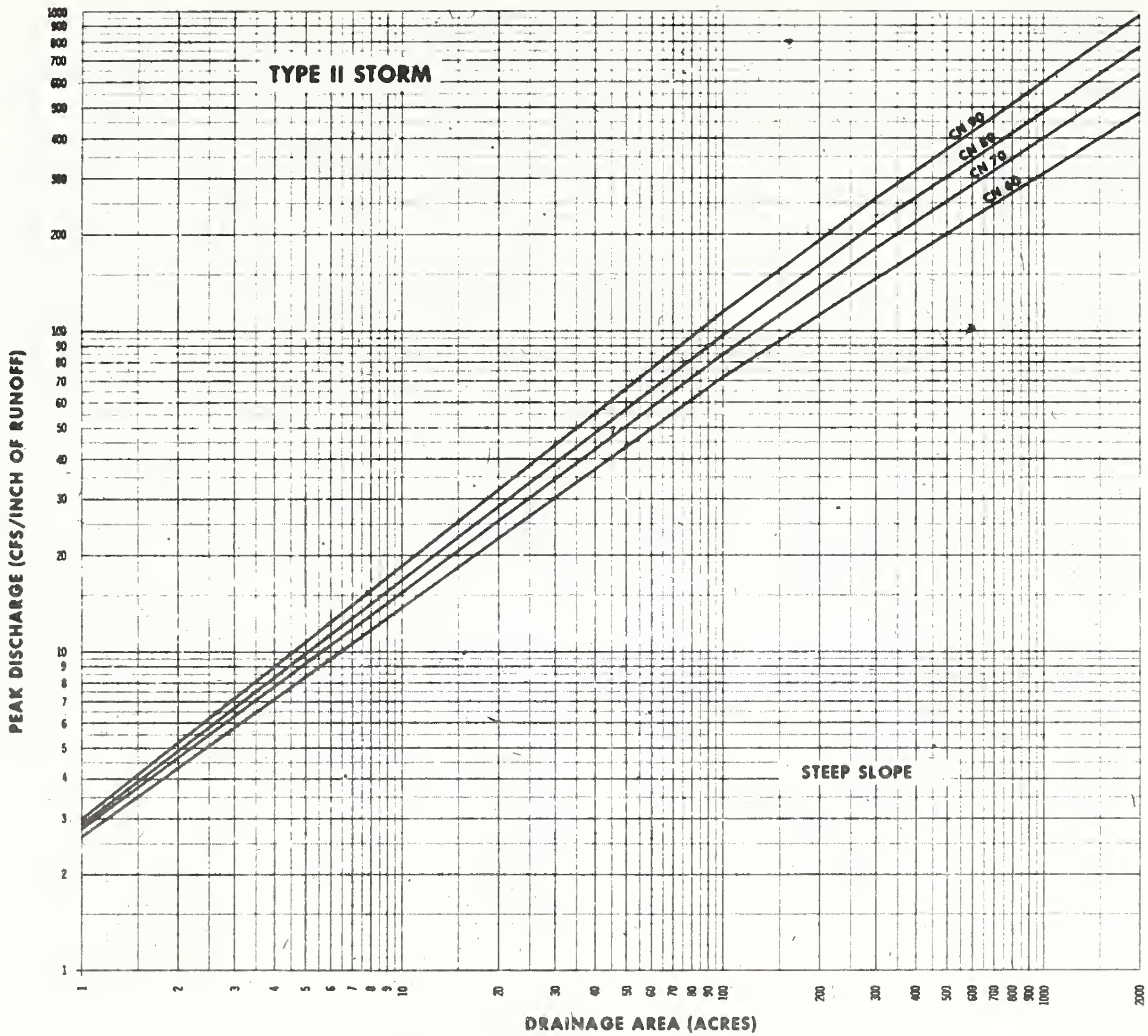


Figure D-2.--Peak rates of discharge for small watersheds (24-hour, type-II storm distribution). Sheet 3 of 3

APPENDIX E

ADJUSTMENT FACTORS FOR PEAKS DETERMINED USING CHARTS IN APPENDIX D

Introduction

This appendix describes methods for adjusting peak rates of discharge for ranges of flat, moderate, and steep slopes; for conditions where swamps or ponding areas exist; and for conditions where the watershed shape factor (ℓ/w) varies significantly from that used in the development of appendix D charts.

Slope Interpolation

Table E-1 provides interpolation factors to be used in determining peak rates of discharge for specific slopes within ranges of flat, moderate, and steep slopes for a range of drainage areas. Appendix D charts for FLAT slope are based on 1-percent slope, for MODERATE slope on 4-percent slope, and for STEEP slope on 16-percent slope. For slopes other than 1, 4, and 16 percent, use the factors shown in table E-1 to modify the peak discharges.

Example E-1

Compute the peak discharge for a 1,000-acre watershed with an average watershed slope of 7 percent and a runoff curve number (CN) of 80 for 4 inches of rainfall.

1. Determine the peak discharge for a watershed with a moderate slope (4 percent). From appendix D, read a peak discharge of 295 cfs per inch of runoff for 1,000 acres and a CN of 80. From table 2-1, find 2.04 inches of runoff for 4 inches of rainfall and a CN of 80. The peak discharge is then 295 x 2.04 or 602 cfs (cubic feet per second).
2. Determine the interpolation factor. From table E-1 find 7-percent slope under MODERATE heading and read an interpolation factor of 1.23 for a drainage area of 1,000 acres. (The peak from a 1,000-acre watershed with a watershed slope of 7 percent is 1.23 times greater than for an average watershed slope of 4 percent.)
3. Determine the peak discharge for 7-percent slope.

$$q = (602)(1.23) = 740 \text{ cfs}$$

Example E-2

Compute the peak discharge for a 15-acre watershed with an average slope of 0.5 percent and a runoff curve number of 80 for 4 inches of rainfall.

1. Determine the peak discharge for a watershed with a flat slope (1 percent). From appendix D read a peak discharge of 11.2 cfs per inch of runoff for 15 acres and a CN of 80. From table 2-1, find 2.04 inches of runoff for 4 inches of rainfall and a CN of 80. The peak discharge is then 11.2 x 2.04 or 23 cfs.

Table E-1.--Slope adjustment factors by drainage areas

Slope (per-cent)	10 acres	20 acres	50 acres	100 acres	200 acres	500 acres	1,000 acres	2,000 acres
FLAT SLOPES								
0.1	0.49	0.47	0.44	0.43	0.42	0.41	0.41	0.40
0.2	.61	.59	.56	.55	.54	.53	.53	.52
0.3	.69	.67	.65	.64	.63	.62	.62	.61
0.4	.76	.74	.72	.71	.70	.69	.69	.69
0.5	.82	.80	.78	.77	.77	.76	.76	.76
0.7	.90	.89	.88	.87	.87	.87	.87	.87
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.5	1.13	1.14	1.14	1.15	1.16	1.17	1.17	1.17
2.0	1.21	1.24	1.26	1.28	1.29	1.30	1.31	1.31
MODERATE SLOPES								
3	.93	.92	.91	.90	.90	.90	.89	.89
4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	1.04	1.05	1.07	1.08	1.08	1.08	1.09	1.09
6	1.07	1.10	1.12	1.14	1.15	1.16	1.17	1.17
7	1.09	1.13	1.18	1.21	1.22	1.23	1.23	1.24
STEEP SLOPES								
8	.92	.88	.84	.81	.80	.78	.78	.77
9	.94	.90	.86	.84	.83	.82	.81	.81
10	.96	.92	.88	.87	.86	.85	.84	.84
11	.96	.94	.91	.90	.89	.88	.87	.87
12	.97	.95	.93	.92	.91	.90	.90	.90
13	.97	.97	.95	.94	.94	.93	.93	.92
14	.98	.98	.97	.96	.96	.96	.95	.95
15	.99	.99	.99	.98	.98	.98	.98	.98
16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	1.03	1.04	1.05	1.06	1.07	1.08	1.09	1.10
25	1.06	1.08	1.12	1.14	1.15	1.16	1.17	1.19
30	1.09	1.11	1.14	1.17	1.20	1.22	1.23	1.24
40	1.12	1.16	1.20	1.24	1.29	1.31	1.33	1.35
50	1.17	1.21	1.25	1.29	1.34	1.37	1.40	1.43

2. Determine the interpolation factor. From table E-1 find 0.5-percent slope under FLAT heading. Read a slope interpolation factor of 0.81 interpolated between the values for 10 acres and 20 acres.

3. Determine the peak discharge for 0.5-percent slope.

$$q = (23)(.81) = 19 \text{ cfs}$$

Adjustment Factors for Swampy and Ponding Areas

Peak flows determined from appendix D assume that the topography is such that surface flow into ditches, drains, and streams is approximately uniform. On very flat areas and where ponding or swampy areas occur in the watershed, a considerable amount of the surface runoff may be retained in temporary storage. The peak rate of runoff should be reduced to reflect this condition. Tables E-2, E-3, and E-4 provide adjustment factors to determine this reduction based on the ratio of the ponding or swampy area to the total watershed area for a range of storm frequencies.

Table E-2 contains adjustment factors to be used when the ponding or swampy areas are located in the path of flow in the vicinity of the design point. Table E-3 contains adjustment factors to be used when a significant amount of the flow from the total watershed passes through ponding or swampy areas and these areas are spread throughout the watershed. Table E-4 contains adjustment factors to be used when a significant amount of the flow passes through ponding or swampy areas that are located only in the upper reaches of the watershed.

Table E-2.--Adjustment factors where ponding and swampy areas occur at the design point

Ratio of drainage area to ponding and swampy area	Percentage of ponding and swampy area	Storm frequency (years)					
		2	5	10	25	50	100
500	0.2	0.92	0.94	0.95	0.96	0.97	0.98
200	.5	.86	.87	.88	.90	.92	.93
100	1.0	.80	.81	.83	.85	.87	.89
50	2.0	.74	.75	.76	.79	.82	.86
40	2.5	.69	.70	.72	.75	.78	.82
30	3.3	.64	.65	.67	.71	.75	.78
20	5.0	.59	.61	.63	.67	.71	.75
15	6.7	.57	.58	.60	.64	.67	.71
10	10.0	.53	.54	.56	.60	.63	.68
5	20.0	.48	.49	.51	.55	.59	.64

Table E-3.--Adjustment factors where ponding and swampy areas are spread throughout the watershed or occur in central parts of the watershed

Ratio of drainage area to ponding and swampy area	Percentage of ponding and swampy area	Storm frequency (years)					
		2	5	10	25	50	100
500	0.2	0.94	0.95	0.96	0.97	0.98	0.99
200	.5	.88	.89	.90	.91	.92	.94
100	1.0	.83	.84	.86	.87	.88	.90
50	2.0	.78	.79	.81	.83	.85	.87
40	2.5	.73	.74	.76	.78	.81	.84
30	3.3	.69	.70	.71	.74	.77	.81
20	5.0	.65	.66	.68	.72	.75	.78
15	6.7	.62	.63	.65	.69	.72	.75
10	10.0	.58	.59	.61	.65	.68	.71
5	20.0	.53	.54	.56	.60	.63	.68
4	25.0	.50	.51	.53	.57	.61	.66

Table E-4.--Adjustment factors where ponding and swampy areas are located only in upper reaches of the watershed

Ratio of drainage area to ponding and swampy area	Percentage of ponding and swampy area	Storm frequency (years)					
		2	5	10	25	50	100
500	0.2	0.96	0.97	0.98	0.98	0.99	0.99
200	.5	.93	.94	.94	.95	.96	.97
100	1.0	.90	.91	.92	.93	.94	.95
50	2.0	.87	.88	.88	.90	.91	.93
40	2.5	.85	.85	.86	.88	.89	.91
30	3.3	.82	.83	.84	.86	.88	.89
20	5.0	.80	.81	.82	.84	.86	.88
15	6.7	.78	.79	.80	.82	.84	.86
10	10.0	.77	.77	.78	.80	.82	.84
5	20.0	.74	.75	.76	.78	.80	.82

These conditions may occur in a proposed or existing urban or suburban area and the adjustment factors from tables E-2, E-3, or E-4 should be applied after the peaks have been adjusted for the effects of urbanization as described in chapter 4.

Example E-3

A 5-acre pond is located at the downstream end of a 100-acre watershed in which a housing development is proposed. The average watershed slope is 4 percent and the present-condition curve number is 75. After the installation of the housing development, 30 percent of the watershed will be impervious and 50 percent of the hydraulic length will be modified. The future-condition curve number is estimated to be 80. For a rainfall

of 6 inches (100-year frequency event) determine the present-condition and future-condition peak discharges downstream of the pond.

1. Determine the present-condition peak discharge assuming the pond is not in place. From appendix D, find the peak discharge to be 59 cfs per inch of runoff. From table 2-1, find the runoff to be 3.28 inches. The peak discharge is then 59 x 3.28 or 194 cfs.

2. Determine the ponding adjustment factor. Since the pond is at the lower end of the watershed, use table E-2. The ratio of the drainage area to pond area is 100/5 or 20. For a 100-year frequency event the adjustment factor is 0.75.

3. Compute the present-condition peak discharge.

$$q = 0.75(194) = 146 \text{ cfs}$$

4. Compute the basic future-condition peak discharge. From appendix D, find the peak discharge to be 65 cfs per inch of runoff. From table 2-1, find the runoff to be 3.78 inches. The peak discharge is then 65 x 3.78 or 246 cfs.

5. Determine the modification factors for proposed urbanization. From chapter 4 and figures 4-1 and 4-2 for a curve number of 80: impervious factor = 1.16; hydraulic length factor = 1.31; urbanization factor = (1.16)(1.31) = 1.52.

6. Compute the future-condition peak discharge.

$$q = 1.52(246) = 374 \text{ cfs}$$

7. Compute the future-condition peak below the pond. From step 2 the ponding factor is 0.75.

$$q = 0.75(374) = 280 \text{ cfs}$$

Adjustment for Watershed Shape Factor

The equation used in computing peak discharges from appendix D was based in part on a relationship between the hydraulic length and the watershed area from Agricultural Research Service's small experimental watersheds. Figure E-1 shows the best fit line relating length to drainage area. The equation of the line is $\ell = 209a^{0.6}$. A watershed shape factor, ℓ/w (where w is the average width of the watershed), is then fixed for any given drainage area. For example, for drainage areas of 10, 100, and 1,000 acres the watershed shape factor is 1.58, 2.51, and 3.98, respectively.

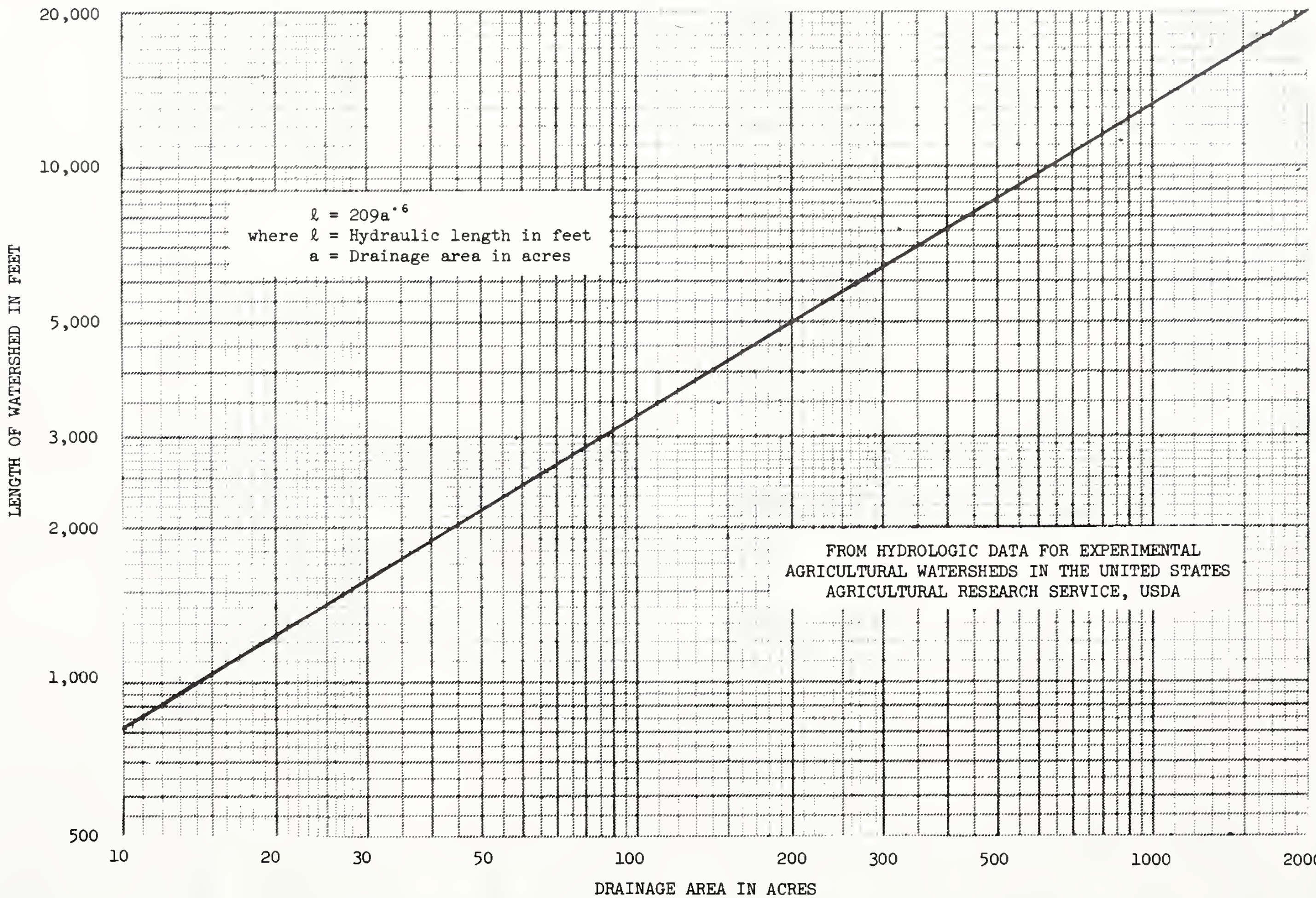


Figure E-1.--Hydraulic length and drainage area relationship.

There are watersheds that deviate considerably from these relationships. The peaks can be modified for other shape factors. The procedure is as follows:

1. Determine the hydraulic length of the watershed and compute an "equivalent" drainage area using $\ell = 209a^{0.6}$ or figure E-1.

2. Determine the "equivalent" peak flow from the charts for the "equivalent" drainage area.

3. Compute the "actual" peak discharge for the watershed by multiplying the equivalent peak discharge by the ratio of actual drainage area to the equivalent drainage area.

The factors for modifying the peak for urbanization following procedures in chapter 4 can then be applied to the revised peak discharge.

Example E-4

From a topographic map the hydraulic length of a 100-acre watershed with moderate slopes and a CN of 75 was measured to be 2,200 feet. Determine the peak discharge for a 6-inch 24-hour rainfall.

1. Determine the "equivalent" drainage area for a watershed with a hydraulic length of 2,200 feet. From figure E-1 read 51 acres. (Note that for a 100-acre watershed the hydraulic length would be 3,300 feet from figure E-1.)

2. Determine the "equivalent" peak flow from appendix D for a drainage area of 51 acres and a CN of 75. Read 37 cfs per inch of runoff. From table 2-1, find the runoff to be 3.28 inches. The peak discharge is then 37 x 3.28 or 121 cfs.

3. Compute the actual peak discharge for 100 acres.

$$\text{actual discharge} = \text{equivalent discharge} \left(\frac{\text{actual drainage area}}{\text{equivalent drainage area}}\right)$$

$$q = 121 \left(\frac{100}{51}\right) = 237 \text{ cfs}$$

   The peak discharge for the 100-acre watershed with a hydraulic length of 2,200 feet is 237 cfs (versus 194 cfs for a "normal" 100-acre watershed). Adjustments to this peak discharge for urbanization can be made using factors discussed in chapter 4.

4. The procedure in steps 1, 2, and 3 can be used to determine peak discharges when the actual hydraulic length is longer than that shown on figure E-1. For example, if the actual length were 4,500 feet instead of 3,300 feet, the equivalent area would be 170 acres, as shown in figure E-1.

APPENDIX F

SAMPLE PEAK DISCHARGE WORKSHEETS

Introduction

Peak discharge worksheets have been developed to provide guidance in the use of TR-55 procedures. The worksheets contain examples that illustrate the use of several TR-55 techniques.

Procedure: Chapter 4 (appendices D & E)

The primary procedure, using chapter 4 with appendices D and E, is illustrated by an example on page F-3. This procedure uses a fixed watershed shape relation (figure E-1) and a fixed lag curve number (CN) relation (figure 3-3). The peak discharge per inch of runoff is read from one of the charts in Figure D-2 using a watershed slope range, drainage area, and CN. Appendix E and urban adjustments may be applied to the chart value, if appropriate.

One of the adjustments, the watershed shape factor, is applied on the worksheet as a muliplication factor and requires a second reading of the Figure D-2 chart. This is a similar but easier to apply procedure than example E-4 in appendix E.

Procedure: Tabular Method (chapter 5)

The Graphical (T_c) - Peak Discharge Worksheet, page F-5, illustrates the procedure using figure 5-2 with a computed time of concentration (T_c). The worksheet example uses the same input as the previous example, but shows a T_c computed by the Lag-CN method. The comparison of peak discharge at the bottom of page F-5 (1% difference between procedures) is meant to show how these procedures are related when a Lag-CN T_c is used. If the T_c is estimated more accurately by some method other than Lag-CN, the Graphical (T_c) procedure should be used. If you do not wish to calculate a T_c or information to develop a T_c is not available, the primary chapter 4 (appendices D and E) procedure is recommended.

Procedure: Tabular Method (chapter 5)

The Tabular Method, a manual procedure to determine peak discharges for complex watersheds, is contained in Chapter 5. Tables 5-1 and 5-2 are samples of how a worksheet can be set up for this procedure.

Use of Worksheets

The slope range (flat, moderate or steep) used in appendices D and E is the average watershed (land) slope. This is not a channel slope. The base slope for each range is given on page E-1 and the factors for interpolation when using other than the base slope is in table E-1.

The worksheets in this appendix give guidance as to which adjustments are required and which, when applicable, are recommended for each procedure. However, some of those recommended may be required modifications in some regions. If not used on the worksheet, a factor of 1.0 is used in the multiplication.

Do not use the ponding and swampy adjustment factor for the design point (table E-2) if the approximate routing procedures in chapter 7 (figures 7-1 or 7-2) are to be used at the design point. This will double count the storage.

A present urban condition is used in the worksheet examples to show how the urban adjustments can be used to estimate peak discharges from watersheds with existing urban areas. The references to future curve numbers in relation to figures 3-4, 3-5 and figures 4-1, 4-2, will be removed in the next revision of TR-55.

Blank worksheets, pages F-7 and F-9 are included.

URBAN HYDROLOGY FOR SMALL WATERSHEDS (TR-55)
PEAK DISCHARGE WORKSHEET
FOR CHAPTER 4 (APPENDICES D & E)

Project ANY CREEK @ US RT. 242 By HR Date 9/29/81
HOWARD COUNTY, SOME STATE Checked WHM Date 9/30/81

Steps Peak Discharge Computations for up to 3 Storms: Type II, Duration 24 hours.

1. Data: Watershed Condition = Present (present or future).

Drainage Area (DA) = 200 acres. Ave. Watershed Slope (S) = 2 %.

2. Runoff Curve Number (CN)

Hydrologic Soil Group (Appendix B)	Land Use Description Include Treatment, Practice & Condition (Table 2-2)	CN (Table 2-2) (3)	~~% or~~ Area (acres) (4)	Product (3)x(4) (5)
C	Cultivated w/o Conservation Treatment	88	120	10560
C	Industrial Area	91	50	4550
C	Residential - 1/8 Ac	90	18	1620
C	Paved Parking Areas	98	12	1176
[Alexandria Cardington Soils]				
		Totals =	200	17906

CN (weighted) = $\frac{\text{total col. (5)}}{\text{total col. (4)}} \left[\frac{17906}{200}\right] = 89.53$; use CN = $\boxed{90}$

	1st Storm	2nd Storm	3rd Storm	
3. Rainfall Frequency (F)	10 YR.	25 YR	100 YR	yrs.
Rainfall Depth (P)	4.0	5.0	6.5	inches
4. Runoff Depth (Q) Use P, CN, and Table 2-1.	2.92	3.88	5.34	inches
	x			
5. Basic Peak Discharge (q) Use S, DA, CN, and Figure D-2.	80			cfs/inch of Q
	x			
*6. Watershed Slope Factor Use S, DA, and Table E-1.	1.29			
	=			
7. Peak Discharge (q_p) where q_p = Steps #4 x 5 x 6	301	400	551	cfs

For graph labeled: (check one)
- ☒ Flat (S = less than 3%)
- ☐ Moderate (S = 3% to 7.9%)
- ☐ Steep (S = 8% & greater)

See Steps 8 to 13 for adjustments that may be applicable.

(TR NOTICE 55-A, September 1981)

TR-55, CHAPTER 4 (APPENDICES D & E), PEAK DISCHARGE WORKSHEET (CONT.)

Steps Peak Discharge Computations with Adjustments

8. Data: Obtain if Adjustments are Applicable

Ponding and Swampy areas (PND) = 4 acres, 2 % of DA
Impervious Area (IMP) = 60 acres, 30 % of DA
Total Hydraulic Length (HL) = 7600 feet
Hydraulic Length Modified (HLM) = 3800 feet, 50 % of HL

	1st Storm	2nd Storm	3rd Storm	
Rainfall Frequency (F) from Step 3	10 YR	25 YR	100 YR	yrs.
Peak Discharge (q_p) from Step 7	301	400	551	cfs
	x	x	x	
*9. Ponding and Swampy Area Peak Factor	.81	.83	.87	
		x		
*10. Watershed Shape Peak Factor		0.78		
		x		
*11. Impervious Area Peak Factor		1.09		
		x		
*12. Hydraulic Length Modified Peak Factor		1.17		
		=		
13. Adjusted Peak Discharge (q_p)	243	330	477	cfs

*9. Ponding and Swampy Area Peak Factor
Use % PND, F, and Tables E-2, 3 or 4.
Location in Watershed: (check one)
- [ ] at Design Point (E-2)
- [x] Center or Spreadout (E-3)
- [ ] Upper Reaches (E-4)

*10. Watershed Shape Peak Factor
Use HL with Figure E-1 and read;
Equiv. Drainage Area (EDA) = 400 acres.

Use Figure D-2 graph from Step 5, CN, and EDA for;
Equiv. Peak/Inch Runoff (q_e) = 125 cfs/in.

$$\text{Factor} = \left[\frac{q_e}{q \text{ from Step 5}}\right] \times \left[\frac{DA}{EDA}\right]$$

$$\text{Factor} = \left[\frac{125 \text{ cfs/in}}{80 \text{ cfs/in}}\right] \times \left[\frac{200 \text{ Ac}}{400 \text{ Ac}}\right] = 0.78$$

*11. Impervious Area Peak Factor
Use % IMP, CN and Figure 4-1.

*12. Hydraulic Length Modified Peak Factor
Use % HLM, CN and Figure 4-2.

13. Adjusted Peak Discharge (q_p)
$q_p = q_p$ (from Step 7) x Steps #9 x 10 x 11 x 12

* If the adjustment is not applicable, enter a Factor of 1.0

URBAN HYDROLOGY FOR SMALL WATERSHEDS (TR-55)
PEAK DISCHARGE WORKSHEET
FOR GRAPHICAL (T_c) METHOD (FIGURE 5-2)

Project ANY CREEK @ US Rt 242 By AR Date 9/29/81
HOWARD COUNTY, SOME STATE Checked WHM Date 9/30/81

Steps Peak Discharge Computation for up to 3 storms: Type II, Duration 24 hours.

1. Data: Watershed Condition = Present (present or future).

Drainage Area (DA) = 200 acres. Ave. Watershed Slope (S) = 2 %.
Ponding and Swampy areas (PND) = 4 acres, 2 % of DA
Impervious Area (IMP) = 60 acres, 30 % of DA
Total Hydraulic Length (HL) = 7600 feet
Hydraulic Length Modified (HLM) = 3800 feet, 50 % of HL

Step	1st Storm	2nd Storm	3rd Storm	Units
2. Rainfall Frequency (F)	10 YR	25 YR	100 YR	yrs.
3. Rainfall Depth (P)	4.0	5.0	6.5	inches

4. Runoff Curve Number (CN) = 90
See other side for computation

Step	1st Storm	2nd Storm	3rd Storm	Units
5. Runoff Depth (Q) Use P, CN, and Table 2-1.	2.92	3.88	5.34	inches
		x		
7. Unit Peak Discharge (q) Use T_c and Figure 5-2		335		csm/inch of Q
		x		
8. Drainage Area		0.31		sq. miles
		x		
*9. Ponding and Swampy Area Peak Factor	.81	.83	.87	
		=		
10. Peak Discharge Area Factor where q_p = Steps #5 x 7 x 8 x 9	246	334	482	cfs

6. Time of Concentration (T_c) = 0.94 hrs.
See other side for computations (check one)
- ☐ Velocity Method
- ☒ Lag-CN Method
- ☐ Other

7. Unit Peak Discharge (q)
Use T_c and Figure 5-2

8. Drainage Area $\left[\frac{DA(acres)}{640(ac/sm)}\right] = \left[\frac{200}{640}\right] =$

*9. Ponding and Swampy Area Peak Factor
Only use % PND, F and Table E-3; when PND is spreadout in watershed and not related to T_c flow path.

10. Peak Discharge Area Factor
where q_p = Steps #5 x 7 x 8 x 9

Peak comparison 246/243 334/330 482/477 Graphical (Tc) / chap 4 Page F-4
(Difference in Methods = 1%)

*If the adjustment is not applicable, enter a Factor of 1.0.

TR-55 GRAPHICAL (T_c) METHOD, PEAK DISCHARGE WORKSHEET (CONT.)

Steps from other side

4. Runoff Curve Number (CN)

Hydrologic Soil Group (Appendix B)	Land Use Description Include Treatment, Practice & Condition (Table 2-2)	CN (Table 2-2) (3)	~~% or~~ Area (acres) (4)	Product (3)x(4) (5)
C	Cultivated w/o Conservation Treatment	88	120	10560
C	Industrial Area	91	50	4550
C	Residential - 1/8 Ac	90	18	1620
C	Paved Parking Areas	98	12	1176
		Totals =	200	17906

CN (weighted) = $\frac{\text{total col. 5}}{\text{total col. 4}} \left[\frac{17906}{200} \right] = \underline{89.53}$; use CN = $\boxed{90}$

5. Time of Concentration (T_c) Select computation method, (a) is recommended.

(a) Velocity Method

Reach	Description of Flow 1/	Length (ft.) (3)	Velocity (ft/sec) (4)	Travel Time (sec.) (3) ÷ (4)
			Totals =	sec.

1/ Use Figure 3.1 for overland flow portion of travel time.

$$T_c = \frac{\text{Total Travel Time (sec.)}}{3{,}600 \text{ (sec./hr.)}} = \left[\frac{\qquad}{3{,}600} \right] = \boxed{\qquad} \text{ hrs.}$$

✓(b) Lag-CN Method

(1) Unadjusted Lag (L)
Use HL, S, CN, and Figure 3-3.
(7600, 2%, 90) — 0.8 hrs.

x

*(2) Hydraulic Length Modified Lag Factor
Use % HLM, CN, and Figure 3-4.
(50%, 90) — 0.80

x

*(3) Impervious Area Lag Factor
Use % IMP, CN, and Figure 3-5.
(30%, 90) — 0.88

x

(4) Constant (T_c = 1.67L) — 1.67

=

(5) Time of Concentration (T_c)
where T_c = (1)x(2)x(3)x(4) — $\boxed{0.94}$ hrs.

URBAN HYDROLOGY FOR SMALL WATERSHEDS (TR-55)
PEAK DISCHARGE WORKSHEET
FOR CHAPTER 4 (APPENDICES D & E)

Project ______________________ By __________ Date __________

______________________ Checked __________ Date __________

Steps Peak Discharge Computations for up to 3 Storms: Type II , Duration 24 hours.

1. Data: Watershed Condition = ______________________(present or future).

   Drainage Area (DA) = __________ acres. Ave. Watershed Slope (S) = __________%.

2. Runoff Curve Number (CN)

Hydrologic Soil Group (Appendix B)	Land Use Description Include Treatment, Practice & Condition (Table 2-2)	CN (Table 2-2) (3)	% or Area (acres) (4)	Product (3)x(4) (5)
		Totals =		

CN (weighted) = $\frac{\text{total col. (5)}}{\text{total col. (4)}}$ [――――――] = __________ ; use CN = ☐

	1st Storm	2nd Storm	3rd Storm	
3. Rainfall Frequency (F)				yrs.
Rainfall Depth (P)				inches
4. Runoff Depth (Q) Use P, CN, and Table 2-1.				inches
		x		
5. Basic Peak Discharge (q) Use S, DA, CN, and Figure D-2. For graph labeled: (check one) ☐ Flat (S = less than 3%) ☐ Moderate (S = 3% to 7.9%) ☐ Steep (S = 8% & greater)				cfs/inch of Q
		x		
*6. Watershed Slope Factor Use S, DA, and Table E-1.				
		=		
7. Peak Discharge (q_p) where q_p = Steps #4 x 5 x 6				cfs

See Steps 8 to 13 for adjustments that may be applicable.

TR-55, CHAPTER 4 (APPENDICES D & E), PEAK DISCHARGE WORKSHEET (CONT.)

Steps Peak Discharge Computations with Adjustments

8. Data: Obtain if Adjustments are Applicable

Ponding and Swampy areas (PND) = ________ acres, ________ % of DA
Impervious Area (IMP) = ________ acres, ________ % of DA
Total Hydraulic Length (HL) = ________ feet
Hydraulic Length Modified (HLM) = ________ feet, ________ % of HL

	1st Storm	2nd Storm	3rd Storm	
Rainfall Frequency (F) from Step 3				yrs.
Peak Discharge (q_p) from Step 7				cfs
	X	X	X	
*9. Ponding and Swampy Area Peak Factor				
*10. Watershed Shape Peak Factor				
		X		
Factor				
		X		
*11. Impervious Area Peak Factor				
		X		
*12. Hydraulic Length Modified Peak Factor				
		=		
13. Adjusted Peak Discharge (q_p)				cfs

*9. Ponding and Swampy Area Peak Factor
Use % PND, F, and Tables E-2, 3 or 4.
Location in Watershed: (check one)
☐ at Design Point (E-2)
☐ Center or Spreadout (E-3)
☐ Upper Reaches (E-4)

*10. Watershed Shape Peak Factor
Use HL with Figure E-1 and read;
Equiv. Drainage Area (EDA) = ________ acres.

Use Figure D-2 graph from Step 5, CN, and EDA for;
Equiv. Peak/Inch Runoff (q_e) = _____ cfs/in.

$$\text{Factor} = \left[\frac{q_e}{q \text{ from Step 5}}\right] \times \left[\frac{DA}{EDA}\right]$$

$$\text{Factor} = \left[\frac{\quad}{\quad}\right] \times \left[\frac{\quad}{\quad}\right] =$$

*11. Impervious Area Peak Factor
Use % IMP, CN and Figure 4-1.

*12. Hydraulic Length Modified Peak Factor
Use % HLM, CN and Figure 4-2.

13. Adjusted Peak Discharge (q_p)
$q_p = q_p$ (from Step 7) x Steps #9 x 10 x 11 x 12

* If the adjustment is not applicable, enter a Factor of 1.0

URBAN HYDROLOGY FOR SMALL WATERSHEDS (TR-55)
PEAK DISCHARGE WORKSHEET
FOR GRAPHICAL (T_c) METHOD (FIGURE 5-2)

Project ______________________ By __________ Date __________

______________________ Checked __________ Date __________

Steps Peak Discharge Computation for up to 3 storms: Type II, Duration 24 hours.

1. Data: Watershed Condition = ______________ (present or future).

Drainage Area (DA) = ________ acres. Ave. Watershed Slope (S) = ________ %.

Ponding and Swampy areas (PND) = ________ acres, ________ % of DA

Impervious Area (IMP) = ________ acres, ________ % of DA

Total Hydraulic Length (HL) = ________ feet

Hydraulic Length Modified (HLM) = ________ feet, ________ % of HL

Step	1st Storm	2nd Storm	3rd Storm	Units
2. Rainfall Frequency (F)				yrs.
3. Rainfall Depth (P)				inches
4. Runoff Curve Number (CN) = ________ See other side for computation				
5. Runoff Depth (Q) Use P, CN, and Table 2-1.				inches
6. Time of Concentration (T_c) = ________ hrs.		X		
7. Unit Peak Discharge (q) Use T_c and Figure 5-2				csm/inch of Q
		X		
8. Drainage Area $\left[\frac{DA(acres)}{640(ac/sm)}\right] = \left[\frac{\qquad}{640}\right] =$				sq. miles
		X		
*9. Ponding and Swampy Area Peak Factor				
		=		
10. Peak Discharge Area Factor where q_p = Steps #5 x 7 x 8 x 9				cfs

Step 6 — See other side for computations (check one):
- ☐ Velocity Method
- ☐ Lag-CN Method
- ☐ Other ________

Step 9 — Only use % PND, F and Table E-3; when PND is spreadout in watershed and not related to T_c flow path.

*If the adjustment is not applicable, enter a Factor of 1.0.

TR-55 GRAPHICAL (T_c) METHOD, PEAK DISCHARGE WORKSHEET (CONT.)

Steps from other side

4. Runoff Curve Number (CN)

Hydrologic Soil Group (Appendix B)	Land Use Description Include Treatment, Practice & Condition (Table 2-2)	CN (Table 2-2) (3)	% or Area (acres) (4)	Product (3)x(4) (5)
		Totals =		

CN (weighted) = $\frac{\text{total col. 5}}{\text{total col. 4}}$ [______] = ______ ; use CN = $\boxed{}$

5. Time of Concentration (T_c) Select computation method, (a) is recommended.

(a) Velocity Method

Reach	Description of Flow [1/]	Length (ft.) (3)	Velocity (ft/sec) (4)	Travel Time (sec.) (3) ÷ (4)
			Totals =	

[1/] Use Figure 3.1 for overland flow portion of travel time.

$$T_c = \frac{\text{Total Travel Time (sec.)}}{3{,}600\ \text{(sec./hr.)}} = \left[\frac{\qquad}{3{,}600}\right] = \boxed{}$$

(b) Lag-CN Method

(1) Unadjusted Lag (L) — ______ hrs.
Use HL, S, CN, and Figure 3-3.

x

*(2) Hydraulic Length Modified Lag Factor — ______
Use % HLM, CN, and Figure 3-4.

x

*(3) Impervious Area Lag Factor — ______
Use % IMP, CN, and Figure 3-5.

x

(4) Constant (T_c = 1.67L) — 1.67

=

(5) Time of Concentration (T_c) — $\boxed{}$ hrs.
where T_c = (1)x(2)x(3)x(4)

(TR NOTICE 55-A, September 1981)

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United States Department of Agriculture

Soil Conservation Service

P.O. Box 2890
Washington, D.C.
20013

November 12, 1981

ENGINEERING - TECHNICAL RELEASE NOTICE 55-A

SUBJECT: SAMPLE PEAK DISCHARGE WORKSHEETS FOR USE IN URBAN HYDROLOGY

Purpose. To supplement Technical Release 55, "Urban Hydrology for Small Watersheds," with a new appendix F.

Effective Date. Effective when received.

Explanation of changes. The enclosed appendix F supplements TR-55 with worksheets and examples for the computation of peak discharges for small watersheds. The appendix provides additional guidance on the use of the TR-55 techniques to improve accuracy and reproducibility of peak flow estimates.

Filing Instructions. Appendix F should be inserted in TR-55 inside the back cover, after appendix E. The notice may be filed inside the front cover. Page 2 of the table of contents should be updated by a pen & ink change to include appendix F.

Distribution. This notice should be distributed to all SCS offices that have copies of Technical Release 55 (dated January 1975).

Copies will be distributed from the National Office only to Federal agencies at their National Office level. States should make copies of this notice available to other Federal, State and local agencies who may be using Technical Release 55.

Additional copies may be ordered from Central Supply by using the order number: TR55A, or Non-SCS from the National Technical Information Service.

Paul M. Howard

PAUL M. HOWARD
Deputy Chief for Technology
Development and Application

Enclosure

(TR Notice 55-A, September 1981)

DIST: TR-55A

APPENDIX F

SAMPLE PEAK DISCHARGE WORKSHEETS

Introduction

Peak discharge worksheets have been developed to provide guidance in the use of TR-55 procedures. The worksheets contain examples that illustrate the use of several TR-55 techniques.

Procedure: Chapter 4 (appendices D & E)

The primary procedure, using chapter 4 with appendices D and E, is illustrated by an example on page F-3. This procedure uses a fixed watershed shape relation (figure E-1) and a fixed lag curve number (CN) relation (figure 3-3). The peak discharge per inch of runoff is read from one of the charts in Figure D-2 using a watershed slope range, drainage area, and CN. Appendix E and urban adjustments may be applied to the chart value, if appropriate.

One of the adjustments, the watershed shape factor, is applied on the worksheet as a muliplication factor and requires a second reading of the Figure D-2 chart. This is a similar but easier to apply procedure than example E-4 in appendix E.

Procedure: Tabular Method (chapter 5)

The Graphical (T_c) - Peak Discharge Worksheet, page F-5, illustrates the procedure using figure 5-2 with a computed time of concentration (T_c). The worksheet example uses the same input as the previous example, but shows a T_c computed by the Lag-CN method. The comparison of peak discharge at the bottom of page F-5 (1% difference between procedures) is meant to show how these procedures are related when a Lag-CN T_c is used. If the T_c is estimated more accurately by some method other than Lag-CN, the Graphical (T_c) procedure should be used. If you do not wish to calculate a T_c or information to develop a T_c is not available, the primary chapter 4 (appendices D and E) procedure is recommended.

Procedure: Tabular Method (chapter 5)

The Tabular Method, a manual procedure to determine peak discharges for complex watersheds, is contained in Chapter 5. Tables 5-1 and 5-2 are samples of how a worksheet can be set up for this procedure.

Use of Worksheets

The slope range (flat, moderate or steep) used in appendices D and E is the average watershed (land) slope. This is not a channel slope. The base slope for each range is given on page E-1 and the factors for interpolation when using other than the base slope is in table E-1.

The worksheets in this appendix give guidance as to which adjustments are required and which, when applicable, are recommended for each procedure. However, some of those recommended may be required modifications in some regions. If not used on the worksheet, a factor of 1.0 is used in the multiplication.

Do not use the ponding and swampy adjustment factor for the design point (table E-2) if the approximate routing procedures in chapter 7 (figures 7-1 or 7-2) are to be used at the design point. This will double count the storage.

A present urban condition is used in the worksheet examples to show how the urban adjustments can be used to estimate peak discharges from watersheds with existing urban areas. The references to future curve numbers in relation to figures 3-4, 3-5 and figures 4-1, 4-2, will be removed in the next revision of TR-55.

Blank worksheets, pages F-7 and F-9 are included.

URBAN HYDROLOGY FOR SMALL WATERSHEDS (TR-55)
PEAK DISCHARGE WORKSHEET
FOR CHAPTER 4 (APPENDICES D & E)

Project ANY CREEK @ US RT. 242 By HR Date 9/29/81
HOWARD COUNTY, SOME STATE Checked WHM Date 9/30/81

Steps Peak Discharge Computations for up to 3 Storms: Type II , Duration 24 hours.

1. Data: Watershed Condition = Present (present or future).

Drainage Area (DA) = 200 acres. Ave. Watershed Slope (S) = 2 %.

2. Runoff Curve Number (CN)

Hydrologic Soil Group (Appendix B)	Land Use Description Include Treatment, Practice & Condition (Table 2-2)	CN (Table 2-2) (3)	~~% or~~ Area (acres) (4)	Product (3)x(4) (5)
C	Cultivated w/o Conservation Treatment	88	120	10560
C	Industrial Area	91	50	4550
C	Residential - 1/8 Ac	90	18	1620
C	Paved Parking Areas	98	12	1176
Alexandria Cardington Soils				
		Totals =	200	17906

CN (weighted) = $\frac{\text{total col. (5)}}{\text{total col. (4)}} \left[\frac{17906}{200}\right] = 89.53$; use CN = 90

	1st Storm	2nd Storm	3rd Storm	
3. Rainfall Frequency (F)	10 YR.	25 YR	100 YR	yrs.
Rainfall Depth (P)	4.0	5.0	6.5	inches
4. Runoff Depth (Q) Use P, CN, and Table 2-1.	2.92	3.88	5.34	inches
	x			
5. Basic Peak Discharge (q) Use S, DA, CN, and Figure D-2. For graph labeled: (check one) ☒ Flat (S = less than 3%) ☐ Moderate (S = 3% to 7.9%) ☐ Steep (S = 8% & greater)	80			cfs/inch of Q
	x			
*6. Watershed Slope Factor Use S, DA, and Table E-1.	1.29			
	=			
7. Peak Discharge (q_p) where q_p = Steps #4 x 5 x 6	301	400	551	cfs

See Steps 8 to 13 for adjustments that may be applicable.

(TR NOTICE 55-A, September 1981)

TR-55, CHAPTER 4 (APPENDICES D & E), PEAK DISCHARGE WORKSHEET (CONT.)

Steps Peak Discharge Computations with Adjustments

8. Data: Obtain if Adjustments are Applicable

Ponding and Swampy areas (PND) = 4 acres, 2 % of DA
Impervious Area (IMP) = 60 acres, 30 % of DA
Total Hydraulic Length (HL) = 7600 feet
Hydraulic Length Modified (HLM) = 3800 feet, 50 % of HL

	1st Storm	2nd Storm	3rd Storm	
Rainfall Frequency (F) from Step 3	10 YR	25 YR	100 YR	yrs.
Peak Discharge (q_p) from Step 7	301	400	551	cfs
	x	x	x	
*9. Ponding and Swampy Area Peak Factor	.81	.83	.87	
*10. Watershed Shape Peak Factor		x 0.78		
*11. Impervious Area Peak Factor		x 1.09		
*12. Hydraulic Length Modified Peak Factor		x 1.17		
		=		
13. Adjusted Peak Discharge (q_p)	243	330	477	cfs

*9. Ponding and Swampy Area Peak Factor
Use % PND, F, and Tables E-2, 3 or 4.
Location in Watershed: (check one)
- [ ] at Design Point (E-2)
- [x] Center or Spreadout (E-3)
- [ ] Upper Reaches (E-4)

*10. Watershed Shape Peak Factor
Use HL with Figure E-1 and read;
Equiv. Drainage Area (EDA) = 400 acres.

Use Figure D-2 graph from Step 5, CN, and EDA for;
Equiv. Peak/Inch Runoff (q_e) = 125 cfs/in.

$$\text{Factor} = \left[\frac{q_e}{q \text{ from Step 5}}\right] \times \left[\frac{DA}{EDA}\right]$$

$$\text{Factor} = \left[\frac{125 \text{ cfs/in}}{80 \text{ cfs/in}}\right] \times \left[\frac{200 \text{ Ac}}{400 \text{ Ac}}\right] = 0.78$$

*11. Impervious Area Peak Factor
Use % IMP, CN and Figure 4-1.

*12. Hydraulic Length Modified Peak Factor
Use % HLM, CN and Figure 4-2.

13. Adjusted Peak Discharge (q_p)

$q_p = q_p$ (from Step 7) x Steps #9 x 10 x 11 x 12

* If the adjustment is not applicable, enter a Factor of 1.0

URBAN HYDROLOGY FOR SMALL WATERSHEDS (TR-55)
PEAK DISCHARGE WORKSHEET
FOR GRAPHICAL (T_c) METHOD (FIGURE 5-2)

Project ANY CREEK @ US Rt 242 By AK Date 9/29/81
HOWARD COUNTY, SOME STATE Checked WHM Date 9/30/81

Steps Peak Discharge Computation for up to 3 storms: Type II, Duration 24 hours.

1. Data: Watershed Condition = Present (present or future).

Drainage Area (DA) = 200 acres. Ave. Watershed Slope (S) = 2 %.

Ponding and Swampy areas (PND) = 4 acres, 2 % of DA

Impervious Area (IMP) = 60 acres, 30 % of DA

Total Hydraulic Length (HL) = 7600 feet

Hydraulic Length Modified (HLM) = 3800 feet, 50 % of HL

Step	1st Storm	2nd Storm	3rd Storm	Units
2. Rainfall Frequency (F)	10 YR	25 YR	100 YR	yrs.
3. Rainfall Depth (P)	4.0	5.0	6.5	inches
4. Runoff Curve Number (CN) = 90 See other side for computation				
5. Runoff Depth (Q) Use P, CN, and Table 2-1.	2.92	3.88	5.34	inches
6. Time of Concentration (T_c) = 0.94 hrs. See other side for computations (check one): ☐ Velocity Method ☒ Lag-CN Method ☐ Other ______		x		
7. Unit Peak Discharge (q) Use T_c and Figure 5-2		335		csm/inch of Q
		x		
8. Drainage Area $\left[\frac{DA(acres)}{640(ac/sm)}\right] = \left[\frac{200}{640}\right] =$		0.31		sq. miles
		x		
*9. Ponding and Swampy Area Peak Factor Only use % PND, F and Table E-3; when PND is spreadout in watershed and not related to T_c flow path.	.81	.83	.87	
		=		
10. Peak Discharge Area Factor where q_p = Steps #5 x 7 x 8 x 9	246	334	482	cfs

Peak comparison 246/243 334/330 482/477 Graphical (Tc) / chap 4 Page F-4

(Difference in Methods = 1%)

*If the adjustment is not applicable, enter a Factor of 1.0.

TR-55 GRAPHICAL (T_c) METHOD, PEAK DISCHARGE WORKSHEET (CONT.)

Steps from other side

4. Runoff Curve Number (CN)

Hydrologic Soil Group (Appendix B)	Land Use Description Include Treatment, Practice & Condition (Table 2-2)	CN (Table 2-2) (3)	~~% of~~ Area (acres) (4)	Product (3)x(4) (5)
C	Cultivated w/o Conservation Treatment	88	120	10560
C	Industrial Area	91	50	4550
C	Residential - 1/8 Ac	90	18	1620
C	Paved Parking Areas	98	12	1176
		Totals =	200	17906

CN (weighted) = $\frac{\text{total col. 5}}{\text{total col. 4}} \left[\frac{17906}{200}\right] = \underline{89.53}$; use CN = $\boxed{90}$

5. Time of Concentration (T_c) Select computation method, (a) is recommended.

(a) Velocity Method

Reach	Description of Flow [1/]	Length (ft.) (3)	Velocity (ft/sec) (4)	Travel Time (sec.) (3) ÷ (4)
			Totals =	sec.

[1/] Use Figure 3.1 for overland flow portion of travel time.

$T_c = \frac{\text{Total Travel Time (sec.)}}{\text{3,600 (sec./hr.)}} = \left[\frac{\quad}{3,600}\right] = \boxed{\quad}$ hrs.

✓(b) Lag-CN Method

(1) Unadjusted Lag (L) — 0.8 hrs.
Use HL, S, CN, and Figure 3-3.
(7600, 2%, 90)

x

*(2) Hydraulic Length Modified Lag Factor — 0.80
Use % HLM, CN, and Figure 3-4.
(50%, 90)

x

*(3) Impervious Area Lag Factor — 0.88
Use % IMP, CN, and Figure 3-5.
(30%, 90)

x

(4) Constant (T_c = 1.67L) — 1.67

=

(5) Time of Concentration (T_c) — $\boxed{0.94}$ hrs.
where T_c = (1)x(2)x(3)x(4)

URBAN HYDROLOGY FOR SMALL WATERSHEDS (TR-55)
PEAK DISCHARGE WORKSHEET
FOR CHAPTER 4 (APPENDICES D & E)

Project ______________________________ By __________ Date __________

______________________________ Checked __________ Date __________

Steps Peak Discharge Computations for up to 3 Storms: Type II, Duration 24 hours.

1. Data: Watershed Condition = ____________________(present or future).

   Drainage Area (DA) = __________ acres. Ave. Watershed Slope (S) = __________%.

2. Runoff Curve Number (CN)

Hydrologic Soil Group (Appendix B)	Land Use Description Include Treatment, Practice & Condition (Table 2-2)	CN (Table 2-2) (3)	% or Area (acres) (4)	Product (3)x(4) (5)
		Totals =		

CN (weighted) = $\frac{\text{total col. (5)}}{\text{total col. (4)}}$ [__________] = __________; use CN = $\boxed{}$

	1st Storm	2nd Storm	3rd Storm	
3. Rainfall Frequency (F)				yrs.
Rainfall Depth (P)				inches
4. Runoff Depth (Q) Use P, CN, and Table 2-1.				inches
		x		
5. Basic Peak Discharge (q) Use S, DA, CN, and Figure D-2. For graph labeled: (check one) ☐ Flat (S = less than 3%) ☐ Moderate (S = 3% to 7.9%) ☐ Steep (S = 8% & greater)				cfs/inch of Q
		x		
*6. Watershed Slope Factor Use S, DA, and Table E-1.				
		=		
7. Peak Discharge (q_p) where q_p = Steps #4 x 5 x 6				cfs

See Steps 8 to 13 for adjustments that may be applicable.

TR-55, CHAPTER 4 (APPENDICES D & E), PEAK DISCHARGE WORKSHEET (CONT.)

Steps Peak Discharge Computations with Adjustments

8. Data: Obtain if Adjustments are Applicable

Ponding and Swampy areas (PND) = ________ acres, ________ % of DA
Impervious Area (IMP) = ________ acres, ________ % of DA
Total Hydraulic Length (HL) = ________ feet
Hydraulic Length Modified (HLM) = ________ feet, ________ % of HL

	1st Storm	2nd Storm	3rd Storm	
Rainfall Frequency (F) from Step 3				yrs.
Peak Discharge (q_p) from Step 7				cfs
	X	X	X	
*9. Ponding and Swampy Area Peak Factor				

*9. Ponding and Swampy Area Peak Factor
Use % PND, F, and Tables E-2, 3 or 4.
Location in Watershed: (check one)
- [ ] at Design Point (E-2)
- [ ] Center or Spreadout (E-3)
- [ ] Upper Reaches (E-4)

*10. Watershed Shape Peak Factor
Use HL with Figure E-1 and read;
Equiv. Drainage Area (EDA) = ________ acres.

Use Figure D-2 graph from Step 5, CN, and EDA for;
Equiv. Peak/Inch Runoff (q_e) = _____ cfs/in.

$$\text{Factor} = \left[\frac{q_e}{q \text{ from Step 5}}\right] \times \left[\frac{DA}{EDA}\right]$$

$$\text{Factor} = \left[\frac{\quad}{\quad}\right] \times \left[\frac{\quad}{\quad}\right] = \text{\_\_\_\_\_\_\_\_}$$

X

*11. Impervious Area Peak Factor
Use % IMP, CN and Figure 4-1. ________

X

*12. Hydraulic Length Modified Peak Factor
Use % HLM, CN and Figure 4-2. ________

=

13. Adjusted Peak Discharge (q_p)
$q_p = q_p$ (from Step 7) x Steps #9 x 10 x 11 x 12

1st Storm	2nd Storm	3rd Storm	
			cfs

* If the adjustment is not applicable, enter a Factor of 1.0

URBAN HYDROLOGY FOR SMALL WATERSHEDS (TR-55)
PEAK DISCHARGE WORKSHEET
FOR GRAPHICAL (T_c) METHOD (FIGURE 5-2)

Project ______________________ By __________ Date __________

______________________ Checked __________ Date __________

Steps Peak Discharge Computation for up to 3 storms: Type II, Duration 24 hours.

1. Data: Watershed Condition = ______________________ (present or future).

   Drainage Area (DA) = __________ acres. Ave. Watershed Slope (S) = __________ %.

   Ponding and Swampy areas (PND) = __________ acres, __________ % of DA

   Impervious Area (IMP) = __________ acres, __________ % of DA

   Total Hydraulic Length (HL) = __________ feet

   Hydraulic Length Modified (HLM) = __________ feet, __________ % of HL

Step	1st Storm	2nd Storm	3rd Storm	Units
2. Rainfall Frequency (F)				yrs.
3. Rainfall Depth (P)				inches
4. Runoff Curve Number (CN) = __________ See other side for computation				
5. Runoff Depth (Q) Use P, CN, and Table 2-1.				inches
6. Time of Concentration (T_c) = __________ hrs. See other side for computations (check one): [ ] Velocity Method [ ] Lag-CN Method [ ] Other __________		X		
7. Unit Peak Discharge (q) Use T_c and Figure 5-2				csm/inch of Q
		X		
8. Drainage Area $\left[\frac{DA(acres)}{640(ac/sm)}\right] = \left[\frac{\quad}{640}\right] =$				sq. miles
		X		
*9. Ponding and Swampy Area Peak Factor Only use % PND, F and Table E-3; when PND is spreadout in watershed and not related to T_c flow path.				
		=		
10. Peak Discharge Area Factor where q_p = Steps #5 x 7 x 8 x 9				cfs

*If the adjustment is not applicable, enter a Factor of 1.0.

TR-55 GRAPHICAL (T_c) METHOD, PEAK DISCHARGE WORKSHEET (CONT.)

Steps from other side

4. Runoff Curve Number (CN)

Hydrologic Soil Group (Appendix B)	Land Use Description Include Treatment, Practice & Condition (Table 2-2)	CN (Table 2-2) (3)	% or Area (acres) (4)	Product (3)x(4) (5)
		Totals =		

CN (weighted) = $\frac{\text{total col. 5}}{\text{total col. 4}}$ [______] = ______ ; use CN = $\boxed{}$

5. Time of Concentration (T_c) Select computation method, (a) is recommended.

(a) Velocity Method

Reach	Description of Flow 1/	Length (ft.) (3)	Velocity (ft/sec) (4)	Travel Time (sec.) (3) ÷ (4)
			Totals =	sec.

1/ Use Figure 3.1 for overland flow portion of travel time.

$T_c = \frac{\text{Total Travel Time (sec.)}}{3{,}600 \text{ (sec./hr.)}} = \left[\frac{\quad}{3{,}600}\right] = \boxed{}$ hrs.

(b) Lag-CN Method

(1) Unadjusted Lag (L) — Use HL, S, CN, and Figure 3-3. ______ hrs.

x

*(2) Hydraulic Length Modified Lag Factor — Use % HLM, CN, and Figure 3-4. ______

x

*(3) Impervious Area Lag Factor — Use % IMP, CN, and Figure 3-5. ______

x

(4) Constant (T_c = 1.67L) 1.67

=

(5) Time of Concentration (T_c) where T_c = (1)x(2)x(3)x(4) $\boxed{}$ hrs.

(TR NOTICE 55-A, September 1981)